NJ TRANSIT

OPERATING INSTRUCTIONS

GP40PH-2
DIESEL-ELECTRIC
LOCOMOTIVES
ROAD NUMBERS
4100 TO 4112
INCLUSIVE

REBUILT BY
CONRAIL
CORPORATION
JUNIATA
LOCOMOTIVE SHOP
ALTOONA PA
1991

TRANSIT

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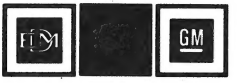


ORIGINAL
OPERATOR'S
MANUAL
PRODUCED BY
EMD, JUNE 1979

REVISED WITH
PERMISSION
BY CONRAIL
CORPORATION
AUGUST 1991

Notice

Information appearing in this manual is intended as an aid in explaining the operation of GP40PH-2 locomotive equipment used by New Jersey Transit operating crews.The information is applicable to the basic EMD locomotive rebuilt to GP40PH-2 specifications by Conrail for New Jersey Transit Rail Operations, Inc.

Information contained in this operator's manual is based on the locomotive remanufactured at Conrail's Juniata Locomotive Shop, Altoona, PA and may not apply to subsequent modifications made by others.

Introduction

This manual has been prepared as a guide for New Jersey Transit personnel engaged in the operation of the 3000 horsepower Model GP40PH-2 diesel-electric locomotive.

Locomotive description and operating instruction are divided into four sections as follows:

1. General Description - Describes principal equipment components.
2. Controls - Explains functions of controls used to start and operate the locomotive and the head end power electric plant. Indicating devices to monitor certain locomotive systems also receive coverage.
3. Operation - Outlines procedures for locomotive operation.
4. Troubleshooting - Describes probable causes of operating trouble and suggests operator action.

To be of more benefit to the reader, these sections should be read in sequence.

Information pertaining to maintenance, adjustment and testing is contained in the Locomotive Service Manual. Instructions for testing and maintenance of individual locomotive components are a part of the standard EMD Maintenance Instruction Bulletin series.

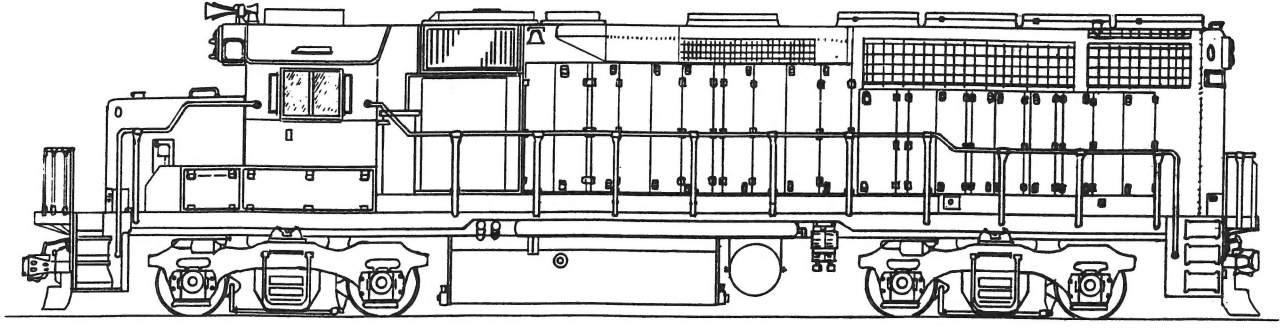
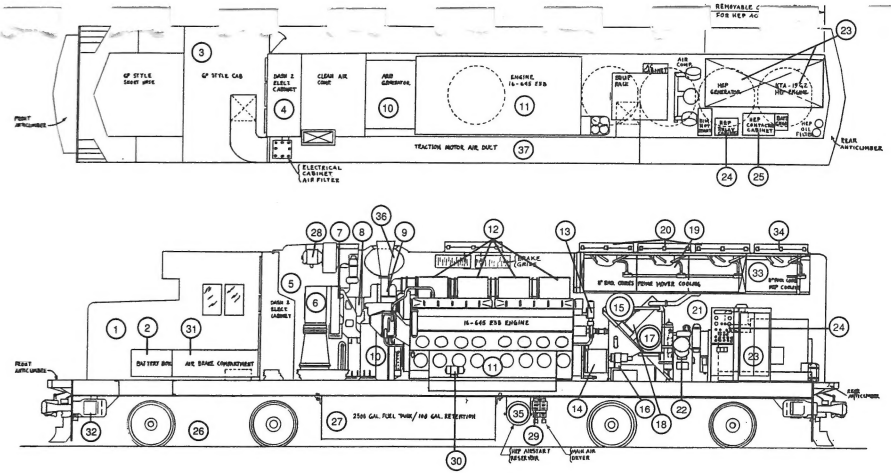


Fig. 1 GP40PH-2 Locomotive



1. Sand Box (Front/Rear)
2. Battery
3. Control Stand
4 Electrical Cabinet
5. Intertial Air Filter
6. Traction Motor Blower
7. Generator Blower
8. Auxillary Generator
9. Turbo Charger
10. Main generator
11. Deisel Engine 16-645E3
12 Exhaust Manifold
13. Engine Generator
14. Lube Oil Strainer
15. Engine Water Tank
16. Fuel Pump
17. Lube Oil Filters
18. Lub Oil Cooler
19. Radiators
20. Radiator Cooling Fan
21. Fuel Filter
22. Air Compressor
23. HEP Plant
24. HEP Relay Cabinet
25. HEP High Vollage Cabinet
26. Truck
27. Fuel Tank
28. Intertial Air Discharge Fan
29. Air Dryer
30. Turbo Lube Oil Pump
31. Air Brake Compartment
32. Coupler/Draft Gear
33. HEP Cooling Expansion Tank
34. HEP Cooling Fan
35. HEP Air Start Reservoirs
36. Exhaust Silencer
37. Main Air Reservoirs
38. Emergency Fuel Cut Off (Both Sides)

Fig. 2 GP40PH-2 Locomotive General Arrangement

General Data

Model Designation GP40PH-2
Locomotive Type ..... (B-B)0440
Locomotive Horsepower 3000
Diesel Engine
Model 645E3B
Type ..... Turbocharged
Number of Cylinders 16
Cylinder Arrangement ..... 45° "V"
Cylinder Bore and Stroke ..... 9-1/16" X 10"
Operating Principle 2 Stroke Cycle, Turbocharged, Unit Injection, Water Cooled
Full Speed ..... 904 RPM
Normal Idle Speed ..... 300 RPM
Low Idle Speed ..... 235 RPM
Main Generator Model AR10A4/D14
Traction Alternator (Rectified Output) AR10
Number of Poles 10
Nominal Voltage (DC) 600
Max. Cont. Rating 4,200Amp
Companion Alternator D14
Nominal Voltage (AC) 215
Number of Poles 16
Frequency (At 900 RPM) 120Hz
Auxiliary Generator Voltage (DC) 74
Rating 18Kw
Traction Motors
Model D77B
Number 4
Type ..... DC, Series Wound Axle Hung
Max. Cont. Rating 1,050Amp
Driving Wheels
Number ..... 4 Pair
Diameter ..... 40"
Tread ..... Tapered

Gear Ratio	Top Speed* MPH	Minimum Continuous MPH
57:20	102	16.3

*Based on 2471 maximum RPM for traction motors.

Air Compressor
- Model ..... Gardner-Denver WBO8114
- Type ..... 2 Stage
- Number of Cylinders 3
- Capacity (At 900 RPM) ..... 254 Cu.Ft./Min.
- Air Compressor Cooling ..... Water
- Lube Oil Capacity ..... 10-1/2 Gal.

Storage Battery
- Number of Cells 32
- Voltage 64
- Rating (8 Hour) ..... 420 Amp Hr.

Supplies
- Lubricating Oil Capacity (Deep Sump Oil Pan) 296 Gal.
- Cooling Water Capacity ..... 275 Gal.
- Fuel Capacity ..... 2500 Gal.
- Sand
  - Front ..... 28 Cu. Ft.
  - Rear ..... 24 Cu. Ft.

Air Brakes Type ..... 26L/CS2 w/ Blended Dynamic

Approximate Weight on Rails ..... 293,650 lbs.

Weight on Drivers 100%

Ecology Tank Capacity ..... 100 Gal.

Major Dimensions
- Width Over Cab Sheeting ..... 10' 1/4"
- Width Over Carbody Access Steps ..... 10' 8"
- Extreme Clearance Height from Top of Rail to Top of Cooling Fan Guards ..... 15' 3-3/4"
- Distance Between Coupler Faces ..... 62'8"

Distance Pulling Face of
Coupler To Bolster Centerline ..... 12' 7"
Distance Between Bolster Centers ..... 37'3"
Minimum Curve Negotiation Capability
Single Unit
134 Ft. Radius - 42° Curve
Two Units Coupled
197 Ft. Radius - 29° Curve
Single Unit Coupled to Std. -
85 Ft. Passenger Car
234 Ft. - Radius - 24° Curve
Head End Power Unit
Cummins Diesel Engine
Model KTA-19G2
Type ..... 4-Stroke Cycle
Aspiration ..... Turbocharged
Number of Cylinders 6
Cylinder Bore ..... 6.25 In.
Cylinder Stroke ..... 6.25 In.
Full Speed ..... 1800 RPM
Lubricating Oil (Total System) ..... 20.5 Gal.
Cooling System ..... 100 Gal.
50/50 Ethylene Glycol
Marathon Alternator
Model ..... 202 BAT 61629
Frame Size 680-8902
Nominal Voltage (AC) 480V
Frequency at 1800 RPM 60Hz
Frequency at 900 RPM 30Hz
Control Voltage (DC) 74
Rating (Standard) ..... 425 Kw

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Section 1

General Description

Introduction

The Remanufactured Model GP40PH-2 diesel-electric locomotive, illustrated in the introduction, is equipped with a turbocharged 16-cylinder 645E3B diesel engine which drives the main generator. Electrical power from the main generator is distributed to the traction motors through the high voltage control cabinet. Each of the four traction motors is geared directly to a pair of driving wheels. The gear ratio of the traction motor to the wheel axle (57:20) determines the maximum operating speed of 102 MPH for the locomotive. The basic locomotive is arranged and equipped so that the short hood or cab end is considered the front or forward part of the unit. However, the locomotive operates equally well in either direction.

The locomotive is designed for single unit or multiple unit operation. When coupled together for multiple unit operation, all units are controlled simultaneously, through low voltage jumper cables, from the control stand in the cab of the lead unit. The Head End Power Plants are not designed for multiple unit operation. Only one HEP Plant is used in multiple locomotive operation.

Locomotive Operation

The majority of components on a locomotive perform functions relating to either the diesel engine or the electrical transmission of power to the driving wheels. The diesel engine is the source of locomotive power. Storage batteries provide the energy required to start the engine. The fuel prime/engine start switch controls battery power to the starting motor solenoids mounted at the lower rear right hand side of the

engine. These electrical solenoids engage the starting motor pinions with the engine ring gear. When each motor pinion is engaged, battery power is applied to the starting motors to crank the engine.

Once started, the engine supplies all power to drive three electrical generators, a multi-cylinder air compressor, and all cooling and engine support systems.

The three electrical generators, the direct current traction motors and the locomotive control system, form the electrical transmission.

The AR10A4 main generator rotates at engine speed. It supplies high voltage AC power to a rectifier assembly which then delivers high voltage DC power to the traction motors for locomotive pulling power.

The D14 companion alternator is physically coupled to the main generator. It supplies current to excite the main generator field and to power the radiator cooling fans, the inertial filter blower motor and various transductors and control devices.

The auxiliary generator provides excitation current to the D14 companion alternator. The auxiliary generator also supplies the power needed for control, cab heating, locomotive lighting and battery charging circuits. Each traction motor is directly geared to an axle and pair of driving wheels. The trucks, which house the motor and wheel arrangements, support all of the locomotive weight, yet provide for flexibility to turn the locomotive and absorb many of the shocks while maintaining maximum traction for the wheels. The excitation and power control system enables the locomotive to utilize the maximum horsepower of the diesel engine over

wide variations in locomotive speed and load. This system consists mainly of electronic components, most of which are mounted on plug-in circuit modules located in the electrical cabinet.

Except for manual operation of the cab controls, locomotive operation is controlled automatically by the excitation and power control system. Various alarms and safety devices will alert the operator should any operating difficulties occur.

Head End Power Supply

The GP40PH-2 locomotive is furnished with a separate diesel-driven electric generator which supplies the electrical power needs of the attendant passenger cars. This generator system operates independently of the primary diesel engine which supplies the driving power of the unit. The Head End Power supply is not required for operation of the locomotive when it is operating without passenger cars.

The Head End Power Unit, or HEP Unit, as this system is referred to in this manual, is powered by a 6 cylinder,4-stroke cycle diesel engine. The alternator supplies 425 Kw of power which is trainlined through four sets of high voltage jumper cables to the passenger cars. The power is supplied at 480 volts and 60 Hz.

Controls for the HEP unit are located in the engine room, with a remote panel in the locomotive cab which permits the operator to control and monitor electrical power generation to the passenger cars.

Section 2

Controls And Indicating Devices

Introduction

This section provides a brief description of controls and indicating devices used by the operator. Although some equipment receiving coverage is not used during normal operation, it is included to familiarize the operator with its function.

The majority of controls and indicating devices used by the operator are located in the locomotive cab, Fig.2-1. Engine starting and monitoring equipment is located in the engine room.

Cab Equipment

Operating equipment is located in the locomotive cab at three locations: the operator's control stand #1 (right side of cab), operator's control stand #2 (left side of cab), and the control cabinet.

Operator's Control Stands

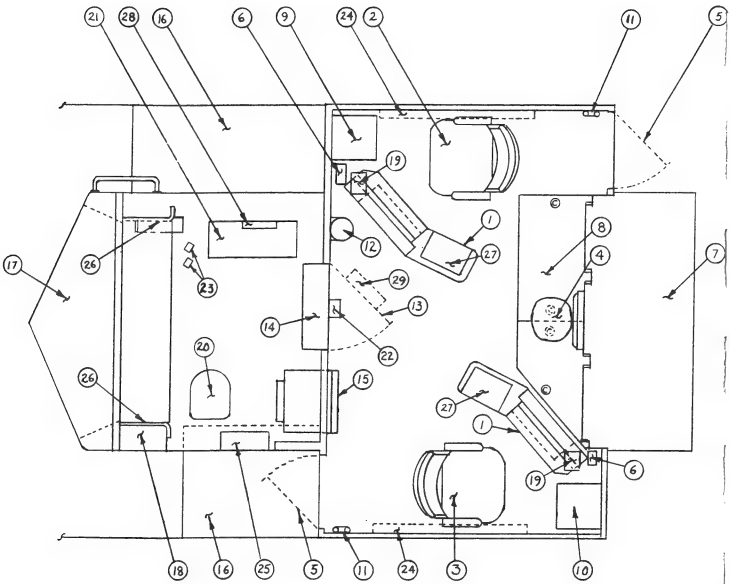
The operator's control stands, Fig. 2-2, contains switches, gauges, and operating handles used by the operator. The individual components are described, together with their functions, in the following paragraphs.

Controller

The following operating handles are located on the locomotive controller, Fig. 2-3.

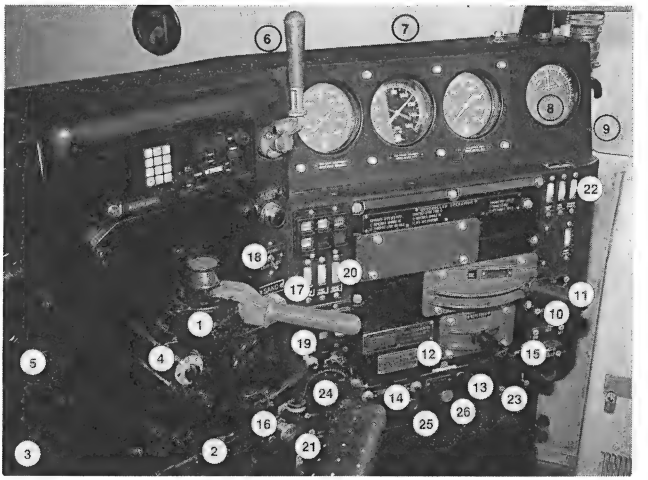
Throttle Handle

The throttle handle, Fig.2-4, is located just above the reverser. It is moved from right to left to increase locomotive power. The handle grip is somewhat out-of-round, with the flattened surfaces horizontal. The throttle has nine different positions;



1. Engineman's Control Stand
2. Engineman's Seat
3. Observer's Seat
4. Folding Seat
5. Cab Door
6. Fuel Level Display
7. Electrical Cabinet
8. Trap Door
9. Cab Heater(Engr. 4.5 KW)
10. Cab Heater(Helper 4.5 KW)
11. Emergency Brake Valve
12. Fire Extinguisher
13. Short Hood Door
14. Step-Down To Short Hood
15. Refrigerator
16. Battery Box
17. Sand Box
18. Hand Brake
19. ADU Cab Signal Aspect Display
20. Toilet
21. Cab Signal Equipment Box
22. CAU Alertor Control Alarm Unit
23. Sanding Magnet Valves
24. Aux. Cab Heater (1.5 KW)
25. L.O.C. Box
26. Collision Post
27. Radio
28. BASP Brake Assurance Panel
29. Fusee Holder

Fig. 2-1 GP40PH-2 Cab Arrangement



1. Automatic Brake Valve
2. Independent Brake Valve
3. Dual Ported Cutout Cock
4. Brake Valve Cut-Off Valve
5. Brake Pipe Air Pressure Regulating Valve
6. Air Horn Valve
7. Air Gauges
8. Load Current Indicating Meter
9. Light Dimmer
10. Headlight Switch-Front
11. Throttle Handle
12. Reverser Handle
13. Ground Reset Button
14. Attendant Call Button
15. Headlight Switch-Rear
16. Bell Ringer Valve
17. Manual Sand Lever Switch
18. Lead Truck Sand Switch
19. Indicator Light Panel
20. Ground and Gauge Light Switches
21. Aux. Sidewall Heaters
22. Control and Operating Switches
23. Strobe Light Switch
24. Hump Control Switch
25. HEP Power ON Switch
26. HEP Power OFF Switch

Fig. 2-2 GP40PH-2 Operator's Control Stand (Typical for both Control Stands)

Fig. 2-3 Locomotive Controller

IDLE and 1 through 8 plus a STOP position which is obtained by pulling the handle outward and moving it forward beyond Idle to stop all engines in a locomotive consist. The throttle cannot be moved when the reverser handle is removed from the controler.

Reverser Handle

Caution

Damage to the traction motors may occur if the reverser is moved from **Forward** to **Reverse** or from **Reverse** to **Forward** while the locomotive is in motion. Therefore, the reverser direction should be changed only when the locomotive is completely stopped.

The reverser handle, Fig. 2-5, is the lowest handle on the controller panel. It has three different posi-

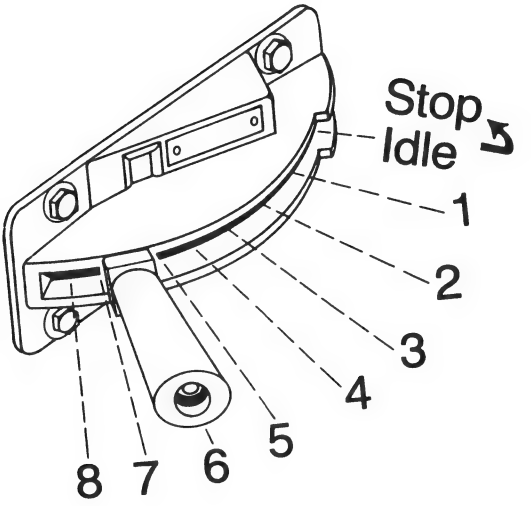


Fig. 2-4 Throttle Handle

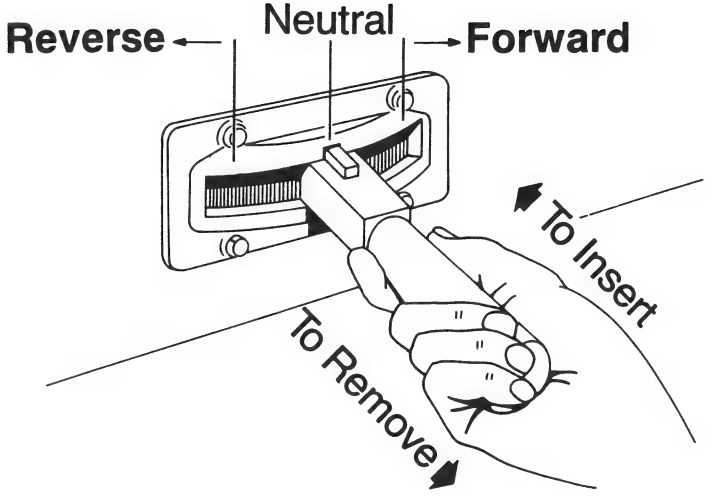


Fig. 2-5 Reverser Handle

tions; left, centered, and right. When the handle is moved forward toward the short hood end of the unit, circuits are set up for the locomotive to move in that direction. When the handle is moved to the rear toward the long hood end, the locomotive will move in that direction when power is applied. With the reverser handle centered, the throttle handle can be moved. In such case, power will not be applied to the traction motors.

The reverser handle is centered and removed from the panel to lock the throttle in Idle position.

Note

Engine speed will be reduced to low idle automatically when the reverser handle is centered, unit is isolated, or whenever the engine run relay is de-energized.

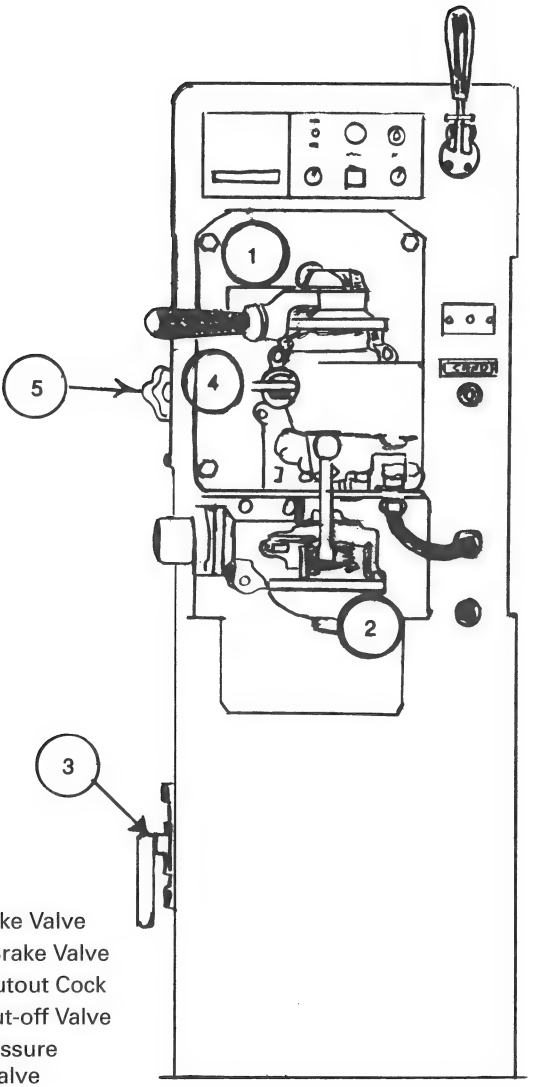
For standard idle speed, the reverser handle should be in either **Forward** or **Reverse** position, isolation switch in **Run** position, and the engine run switch closed (**Up** position).

Mechanical Interlocks on the Controller

The handles on the controller are interlocked so that:

1. With reverser handle in **neutral** (centered) -
   a. Throttle can be moved to any position.
   b. Reverser handle can be removed from controller if throttle is in **Idle** position.
2. With reverser handle in **Forward** or **Reverse**, throttle can be moved to any position.
3. With reverser handle removed from controller, the throttle is locked in **Idle** position.
4. With throttle in **Idle** position, the reverser handle can be placed in **neutral**, **Forward**, or **Reverse** position.

5. With throttle above **Idle** position, the reverser handle cannot be moved.



1. Automatic Brake Valve
2. Independent Brake Valve
3. Dual Ported Cutout Cock
4. Brake Valve Cut-off Valve
5. Brake Pipe Pressure Regulating Valve

Fig. 2-6 Air Brake Valves

26L/CS2 Air Brake Equipment

This locomotive is equipped with type 26L/CS2 air brake equipment. This equipment is located to the left of each controller and, as shown in Fig. 2-6, includes an electro-pneumatic automatic brake, independent brake, cut-off valve, a trainline air pressure regulating valve, and a multiple unit valve (on the No. 1 control stnd only).

A dead engine feature is also part of the 26L air brake equipment. The dead engine cut-out cock and pressure regulator, Fig. 2-7, are accessible from outside the locomotive underneath the cab on the right side through side doors provided. The pressure regulator is set by maintenance personnel and is not to be set by the operator. The dead engine cut out cock is closed for normal locomotive operation.

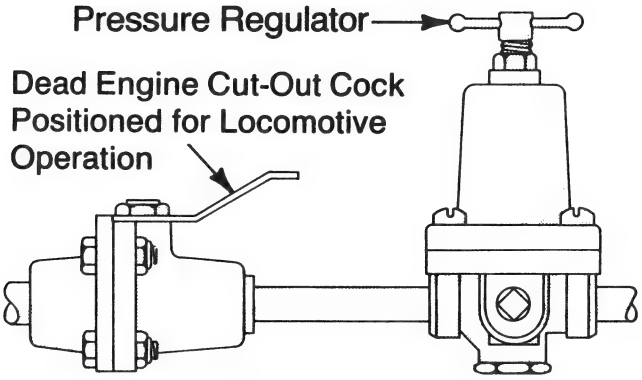


Fig. 2-7 Dead Engine Cutout Cock and Pressure Regulator

Note

This locomotive is equipped with a blended brake system which is a "blending" of dynamic braking into the normal air brake system. The combining of

the two systems is done automatically when the automatic brake valve handle is put in a service application position and the throttle handle is in **Idle**. The blended brake is nullified at speeds below 4 MPH. The locomotive will not transfer into blended or dynamic braking when the locomotive is at standstill.

Minor fluctuations in brake cylinder pressure may be caused by the normal operation of the blended brake system and should not be cause for alarm.

Warning

When operating the locomotive with the Blended and Dynamic Brake Cutout switch in the **Cutout** position, anticipated stopping distances using the locomotive automatic brake valve could be considerably lengthened.

Automatic Brake Valve

The 26E automatic brake valve, Fig. 2-8, is used to control the application and release of both the locomotive and train brakes. The brake valve is of the "self-lapping type" which will hold brake pipe pressure constant against nominal brake pipe leakage. It is a "position" type brake valve, that is to say it is "non-self-lapping". A brief description of the operating positions follows:

Release Position

This position is for charging the brake pipe and releasing the locomotive and train brakes. It is located with the handle in the first notch, at the extreme left of the quadrant.

Holding Position

This position is located with the handle in the second notch, which is in the quadrant to the right of release position. In the hold position, the brake pipe is recharged to its full release pressure. If the

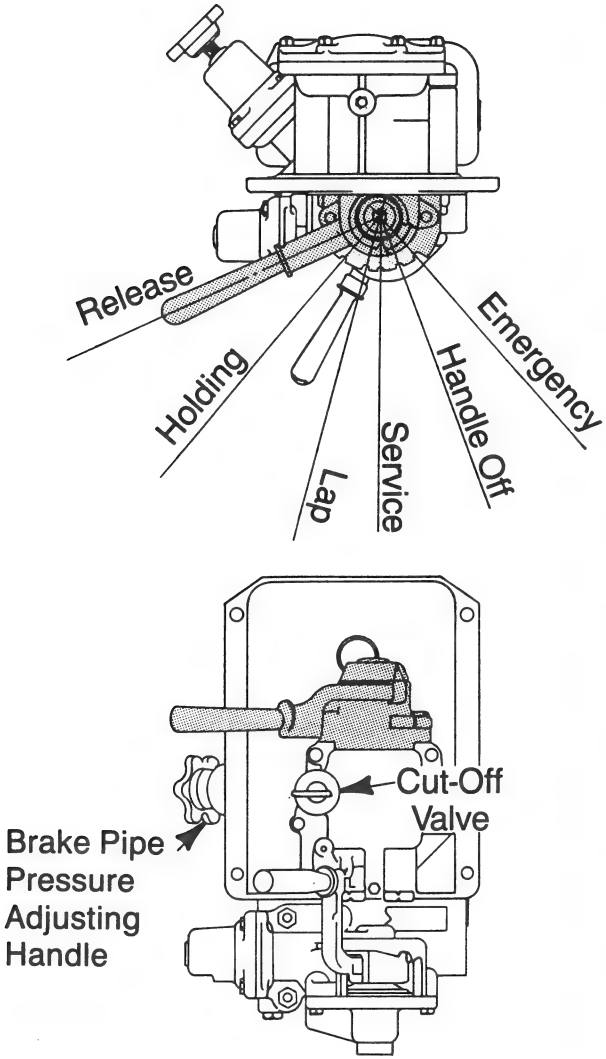


Fig. 2-8 26E Automatic Brake Handle Positions

locomotive is being operated in the electro-pneumatic (EP) mode, a switch in the brake valve is closed in a hold position which energizes the hold magnet valve on the locomotive and, in a like manner through the locomotive/car electrical trainlines, energizes the hold magnet valve on each car. This holds brakes applied on the entire train, while at the same time permitting a recharge of the brake pipe.

Note:

The holding position is to be used during the electro-pneumatic operation only. When E-P brake system is either cut-out or inoperative, this position is the same as the release position.

Lap Position

This position is at the third notch position. After a desired reduction of equalizing reservoir pressure has been made with the handle in the service position, the brake valve handle is moved to the Lap position. The Lap position stops any further reduction of equalizing reservoir pressure, which stabilizes brake pipe pressure at the same level as the equalizing reservoir pressure. The relay portion of the brake valve will maintain brake pipe pressure at this level, automatically adjusting for leakage.

Service Position

This position is at the fourth notch position in the valve body. When the brake valve handle is placed in this position, equalizing reservoir pressure is reduced at the service rate. The equalizing reservoir causes a reduction of brake pipe pressure to the reduced value at a service rate. This develops brake cylinder pressure which causes a service brake application. With the handle, in the service position, the reduction of equalizing reservoir, and subsequent brake pipe pressure will continue until

the brake valve handle is moved to the Lap position. In addition to providing service braking forces, suppression of penalty application from overspeed or safety control is obtained in this position.

If the locomotive is operating in the electro-pneumatic (EP) mode the service position closes a switch in the brake valve that operates an application magnet valve on the locomotive and, through the electrical locomotive/car trainlines energizes a similar magnet valve on each car so equipped. Each application magnet valve locally reduces brake pipe pressure simultaneously through the entire train. This then develops a retarding force throughout the train at a quick but uniform rate. Moving the brake valve handle to Lap position de-energizes the application magnet valve and stops the local reduction of brake pipe pressure at each car.

Handle Off Position

This position is located in the next notch to the right of the service position. Placing the handle in Handle Off position causes a full-service brake application. The valve body is machined at this location to enable removal of the brake valve handle by moving it straight upwards.

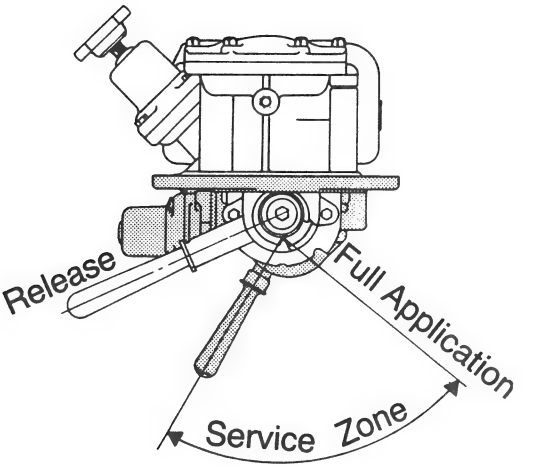
Emergency Position

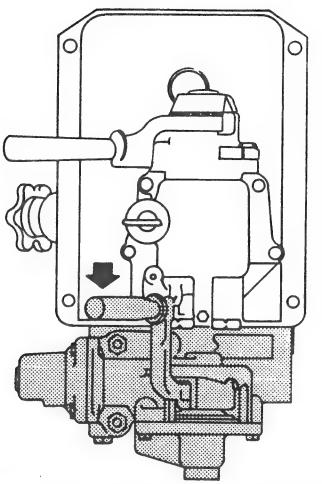
This position is located to the extreme right of the brake valve quadrant. It is used for making emergency brake application and for resetting the brake equipment after an emergency application for any cause.

Independent Brake Valve

The independent brake valve, Fig. 2-9, is located directly below the automatic brake handle.

This valve provides independent control of the locomotive braking effect irrespective of train brak-





Press Handle Down to Release
Automatic Application of
Locomotive Brakes

Fig. 2-9 Independent Brake Handle Positions

ing effort. The brake valve is self-lapping and will hold the brakes applied. A brief description of the operating positions follows.

Release Position

This position is located with the handle at the extreme left of the quadrant. This position releases the locomotive brakes, provided the automatic brake handle is also in release position.

Full Application Position

This position is located with the handle at the extreme right of the quadrant. In moving the handle from left to right through the service zone the degree of locomotive braking effort is increased until full application braking effort is obtained.

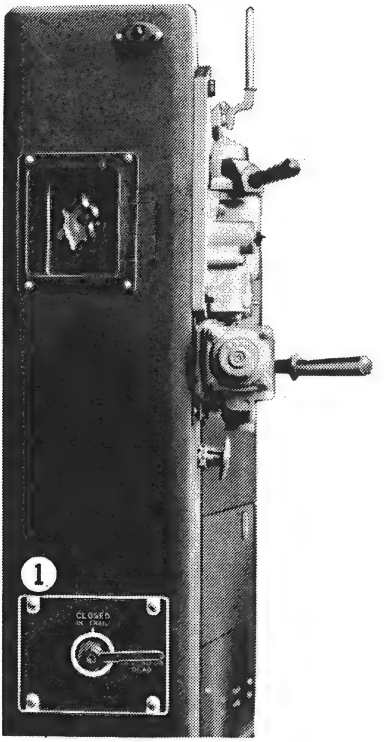
Depression of the independent brake handle whenever the handle is in release position will cause the release of any automatic brake application existing on the locomotive. Depression of the independent brake handle when in the service zone will release the automatic application of the locomotive brakes to the valve corresponding to the position of the independent brake handle.

Dual Ported Cutout Cock (No. 1 Control Stand Only)

The dual ported cut-out cock is located on the lower left side of the No-1 operators control stand. F1G 2-10. It's purpose is to enable the air brake equipment of one locomotive unit to be controlled by that of another unit. The cut-out cock is positioned by turning the lever to the desired setting.

The dual ported cut-out cock has two positions:

1. **In/Open**—The handle is the horizontal position for lead or dead.
2. **Out/Closed**—The handle is in the vertical position for trail.



1. Dual Ported Cutout Cock

Fig. 2-10 Dual Ported Cutout Cock

Cut-Off Valve

The cut-off valve, Fig. 2-6, is located on the automatic brake valve housing directly beneath the automatic brake handle. The valve has the following two positions:

1. **Out**

2. **In**

To operate locomotive as the controlling unit, the cut-off valve handle must be pushed in and rotated to the **In** position. The **Out** position is used when hauling the locomotive "dead" or as a trailing unit in a consist.

Brake Pipe Air Pressure Regulating Valve

The brake pipe air pressure adjusting valve, Fig.2-6, is located to the left rear of the automatic brake valve.

With the automatic brake valve handle in release position, it is used to obtain the brake pipe pressure desired. The automatic brake valve will maintain the selected pressure against overcharge or leakage.

26L Air Brake Equipment Operating Positions

For New Jersey Transit recommended practices, refer to Fig.2-11 for brake equipment operating positions most often encountered while the locomotive is in service.

Controls and Switches

The following paragraphs describe controls, switches, and indicators provided in the operator's control stand, Fig. 2-2.

Air Horn Valve

When the air horn lever is pulled, compressed air is supplied to the locomotive air horn and the locomotive signal bell..

Sanding Switches

Sanding Lead Truck Toggle Switch

The signal from this switch is not trainlined. The switch provides sand to only the lead truck. This method of sanding dresses the rail and is adequate for most conditions. The white SAND light will come on when this switch is activated.

Sand Lever Switch

When operated, this lever supplies a signal to the sanding module. The sanding module determines which direction the locomotive is moving and directs the trainlined signal to the appropriate (for-

26E VALVE	N.J. TRANSIT LOCOMOTIVES: GP40PH-2						
	OPERATOR CONTROL STAND				BRAKE CABINET		
SERVICE	Cut-off Valve	Automatic Brake Valve Handle	Dual Ported Cut-Out Cock	Independent Brake Valve Handle	Dead Engine Cut-Out Cock	Overspeed Cut-Out Cock	Alertor Cut-Out Cock
SINGLE/LEAD	In	Release	In/Open	Release	Closed	Open	Open
PUSH	Out	Handle Off	In/Open	Release	Closed	Open	Open
TRAIL 24 OR 26	Out	Handle Off	Out/Closed	Release	Closed	Open	Open
TOWED	Out	Handle Off	In/Open	Release	Open	Closed	Closed

Fig. 2-11 26L/CS2 Air Brake Equipment Positions

ward or reverse) sanding magnet valves. The basic switch is a latching type, however, movement of the sand switch in either direction provides whatever sanding is called for by the sanding module. The SAND light will come on when this switch is activated.

Bell Ringer Valve

This mushroom type valve actuator operates the locomotive signal bell.

Light Dimmer

This rheostat controls the brightness of the control panel illumination lighting.

Auxiliary Heater Switch

This switch powers the auxiliary strip heater on the operator's side of the cab.

Strobe Light Switch

The switch which controls the cab-roof mounted strobe lights has three operating positions.

Note

The front headlight switch must also be ON in any position for the strobe lights to operate

Off - This position disconnects electric power to the lights.

Manual - This position activates the strobe lights.

Auto - This position automatically operates the strobe lights during bell ringing or horn blowing.

Snow Brake Switch

This switch, when energized, will provide a constant 7-10 pound brake application. This light application of the brake shoes to the wheels will cause a friction that heats up the wheels and prevents ice from forming on them during freezing weather.

HEP Power On Switch

This button is used to close the main contactor which feeds power to the passenger cars. The button should only be pressed after the green HEP Ready Indicator Light (Fig.2-12) comes on.

HEP Power Off Switch

This button is used to open the main feed contactor and discontinue power feed to the passenger cars.

Radio Selector Switch (No. 1 Control Stand Only)

This toggle switch is used to select which radio is to be used:

Front Radio - This position selects radio on No. 1 Control Stand.

Back Radio - This position selects radio on No. 2 Control Stand.

Power Reduction Controls

These controls, Fig. 2-12, are located on the operator's control stand.

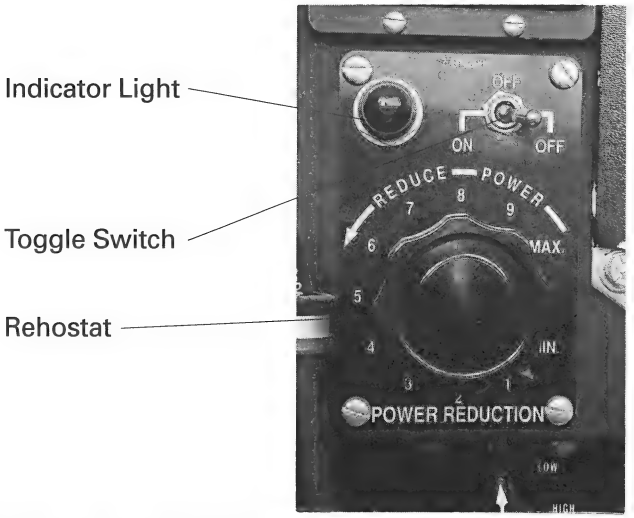


Fig 2-12 - Power Reduction Controls

Power Reduction Indicator Light

The power reduction indicator light is on only when the power reduction toggle switch is in the **On** position, which means that the setting of the power reduction rheostat is affecting traction power. The indicator light is off when the toggle switch is **Off**.

Power Reduction Toggle Switch

When the power reduction toggle switch is in the **On** position, the power reduction rheostat on that control stand controls power reduction on the locomotive.

When the power reduction toggle switch is in the **Off** position, the power reduction rheostat on that control stand has no effect.

Note

If the power reduction toggle switch on either control stand is in the **On** position, the power reduction toggle switch on the other control stand should be in the **Off** position.

Power Reduction Rheostat

When activated by the **On** position of the power reduction toggle switch, the power reduction rheostat overrides the power level called for by the throttle. For example, if the rheostat is set to reduce power by 1/3, it will do so in each throttle position. When set in the **Max** position, fully clockwise, the rheostat permits normal power in each throttle position.

Note

Power reduction is not trainlined.

Indicator Light Panel No. 3

The indicator light panel, Fig. 2-13-A, contains

lights to indicate operation of various systems within the locomotive. The panel has press-to-test lights covered by colored lens caps identified in black letters. The three lights provided are discussed in the following paragraphs.

Fig.2-13-A No. 3 Indicator Light Panel

Note

The following indicator lights have a press-to-test feature which allows testing of the lamp circuit alone, isolated from its operation in the power control system. When the lens cap is depressed the supply voltage is impressed across the lamp circuit. After a one second delay the light should go on.

Wheel Slip Light

Intermittent flashing of the white wheel slip light indicates that the wheel slip control system has been activated and is doing its job, correcting the slips. The throttle and locomotive power should not be reduced unless severe lurching threatens to break the train.

Note that minor slips or wheel creep will not acti-

vate the wheel slip light, but automatic sanding may take place along with regulation of power to the wheels. Do not misinterpret this power control as loss of power due to a fault. The sand light will be lit if the wheel slip module calls for the application of sand from the sanding module.

Warning

A wheel slip light flashing persistently or burning continuously may indicate a pair of sliding wheels or circuit difficulty. Stop the locomotive and make a careful inspection to ascertain that there are no locked sliding wheels.

PCS Open Light

The white PCS open light comes on to indicate a penalty or emergency air brake application. The pneumatic control switch PCS functions to automatically cut power to the traction motors in the event of a safety control air brake application, emergency air brake application, the end or center doors open on passanger cars.

Locomotive power is restored by resetting of the PCS switch. This occurs automatically, provided that:

1. Control of the air brake is recovered
2. The throttle is returned to Idle position.
3. Passanger car end and center doors are closed.

Sand Light

This white light comes on to indicate that sand is being applied to the lead axle. The light is not affected by the manual, emergency, or wheel slip sanding circuits.

Brake Warn Light

Indicates excessive dynamic braking current. The

buzzer will sound when the light comes on. If the brake warning indication repeats, place the blended and dynamic brake cut-out switch on the engine control panel of the affected unit in the **Cut-out** position. The unit will then operate normally under power, but the total braking effort of the consist will be reduced due to less than a blended full service application, thus increasing stopping distance.

HEP Ready Light

The Green HEP Ready Light comes on to indicate that the 480V AC HEP power is ready to be applied to the HEP power trainline and that all safety circuits have been satisfied.

HEP Fault Light

The Red HEP Fault Light comes on to indicate that the AC contactor has opened up due to a fault detected by the HEP safety circuits and has removed the 480V AC HEP power from the trainline.

Indicator Light Panel No.4

The indicator light panel, Fig.2-13-B, contains lights to indicate operation of the hand brake system in the locomotive and passenger cars, and door closure in the passenger cars. The panel has press-to-test light covered by colored lens caps identified in black letters. The three lights provided are discussed in the following paragraphs:

Handbrake Apl. (Applied Light)

When the locomotive handbrake or passenger car handbrakes are applied, the blue light will come on.

End Door Closed Light

This Green light will come on when the end doors in the passenger cars are closed.

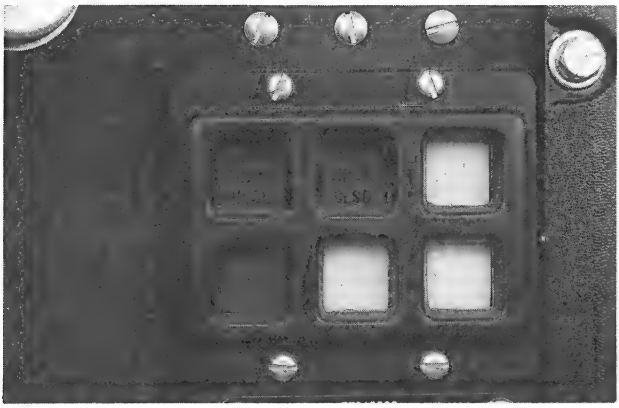


Fig.2-13-B No.4 Indicator Light Panel

Center Door Closed Light

This Green light will come on when the center doors in the passenger cars are closed.

Ground, Step And Gauge Light Switches

Switches for the ground lights, step lights, and gauge lights are located to the left of the controller (Fig.2-2). The lights are on when the switches are in the up position.

Headlight Switches

Two four-position rotary snap switches are provided for independent control of the front and rear headlights (Fig.2-2). Each switch has **Off**, **Dim**, **Med.**, and **Brt.** positions. All positions of each switch are operative. The front headlight switch must be **On** in any position for the strobe lights to operate.

Control And Operating Switches

A group of three operating switches, Fig.2-14, is located at the upper right corner of the control stand. They snap into the **On** position when moved upward. The switches must be **On** in the

lead unit when units are coupled together, and **Off** in trailing units.

Engine Run Switch

This switch must be **On** to obtain throttle control of engine speed. If the engine run switch is **Off**, the engine will run at low idle speed regardless of throttle handle position.

Gen. (Generator) Field Switch

The Generator field switch must be **On** to complete the excitation circuits to the main generator. If the switch is in the **Off** position, the engine will respond to throttle, but the generator will not develop power.

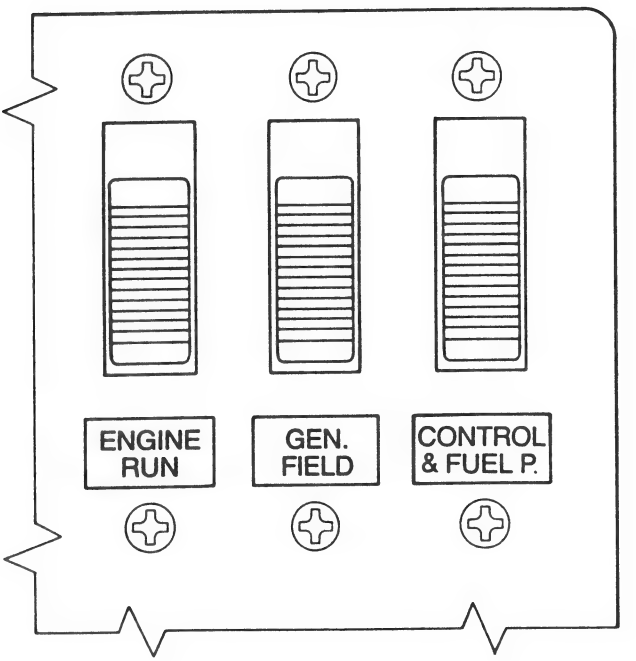


Fig.2-14 Control and Operating Switches

Control & Fuel Pump Switch

Provides power to various low voltage control circuits. The switch must be **On** to start the engine and operate the fuel pump. This switch must be in the **On** position at both control stantds

Conductor's Signal Pushbutton

When this button is pressed, the conductor's buzzer will sound and a signal will be given through the communication trainline to the passenger cars.

Ground Relay Reset Pushbutton

To restore locomotive power and reset the ground relay when the ground relay tripped light is on, wait 10 seconds, then press the ground relay reset pushbutton (Fig.2-2). Power will then reapply. It is not necessary to isolate the unit, or have the throttle in **Idle** while pressing the button unless the locomotive is at a standstill.

Repeated resetting of the ground relay is permissible, but instructions issued by NJ Transit regarding repeated resetting must be followed. However, in the absence of definite instructions to the contrary, isolate a unit when the ground relay light comes on for a fourth time after being reset three times.

Caution

Report any ground relay alarm indications to proper maintenance personnel.

Air Gauges

Three air gauges that indicate various pressures concerned with the air brakes are located along the top of the control stand. The air gauges are discussed above, going from left to right.

Left Gauge Red (Needle) - Main Reservoir

White (Needle) - EQ'LG. (Equalizing) Reservoir

The red needle on this gauge indicates main reservoir pressure which normally will be 130 to 140 psi.

The white needle shows equalizing reservoir pressure which is normally the same pressure as the brake pipe, 110 psi when the brake system is charged and the brakes released. Equalizing pressure reduces when the automatic brake valve is used to apply brakes.

Center Gauge

Red (Needle) - Brake Cylinder

White (Needle) - Brake Pipe

The red needle indicates the brake cylinder pressure. The needle will indicate 0 psi when the brakes are released. The pressure will increase as brakes are applied with either automatic brake valve or independent brake valve. A full service brake application will indicate 62 psi. The maximum application of the independent brake valve will indicate 72 psi.

The white needle shows brake pipe pressure. This pressure is normally 110 psi when the brake system is charged and the brakes released.

Brake pipe pressure reduces along with equalizing reservoir when the automatic brake valve is used to apply brakes.

Right Gauge

Red (Needle) - Appl'n (Application) Pipe

White (Needle) - Suppr. (Suppression Pipe)

The red needle displays main reservoir pressure which is normally 130 - 140 psi, except during a

penalty brake application, at which time application pipe pressure will reduce.

The white needle indicates brake suppression pipe pressure which is normally at zero. If a penalty application is successfully suppressed by the engineer, this gauge will display main reservoir pressure, until penalty application has been recovered.

Load /Brake Current Indicating Meter

Locomotive pulling force is indicated by the load current indicating meter (Fig.2-15). The meter is graduated to read amperes of electrical current, with 1500 being the maximum on the scale. A red area on the meter face indicates when current levels are too high for continuous operation. The meter is connected to the number two traction motor and indicates traction motor current.

The maximum continuous current rating of the traction motors and the value given on the traction motor short time rating plate is applicable only when operating at throttle No. 8 engine speed. These values decrease as engine speed and cooling air is decreased.

Note

If the No.2 traction motor is cut out, there will be no reading on the load current meter. Whenever a traction motor is cut out, control circuits limit locomotive power to allow continued operation to the next maintenance point. The meter needle swings to the right of zero to indicate load current power operation, and it swings to the left of zero to indicate dynamic braking current, with 800 amperes being the maximum reading on the braking portion of the meter.

Note

The wheel slip control system functions to correct slips by instantaneous reduction of power in small increments and by application of sand. The cumulative effect of a large number of power reductions in rapid succession is to cause the locomotive to maintain power at a level where adhesion can be maintained. Do not misinterpret this loss of power as a defect in the control system.

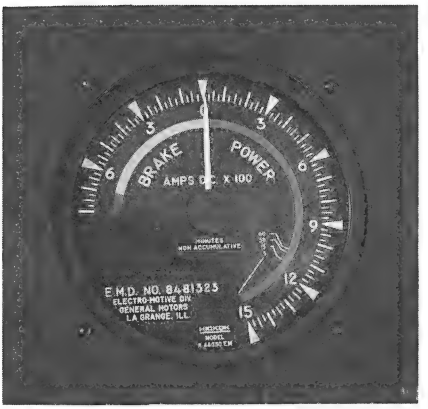


Fig. 2-15 Load Current Indicating Meter

Control Cabinet

The control cabinet contains an engine control panel, a fuse and switch panel, and three circuit breaker panels, Fig.2-16. Each panel contains controls and/or indicating devices used by the operator.

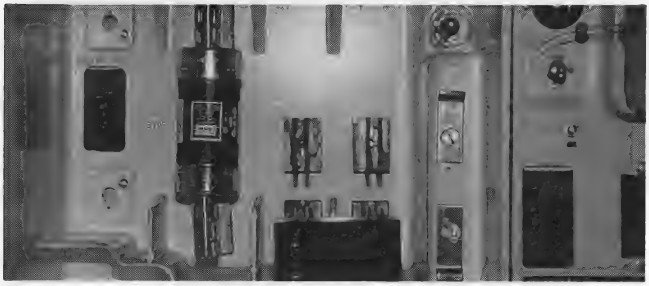


Fig.2-16 Control Cabinet Panels

Warning

Never open any control cabinet doors other than to gain access to the circuit breaker and fuse and switch panels. High electrical voltage and current are present throughout the control cabinet.

Engine Control Panel

The engine control panel, Fig.2-17, contains various switches and individual indicator lights to alert the operator to various operating conditions. Since all of these devices will be used by the operator, a brief description of their functions is provided.

This unit is equipped with light panel No. 1 (Fig.2-18) and a second indicator light panel, (Fig.2-19).

An alarm bell accompanies an alarm signal light indication. The bell will ring in all units of a locomotive consist, but the light will come on only in the affected unit.

Fig.2-17 Engine Control Panel

Note

Indicator light panels are equipped with push-to-test lights. This feature allows testing of the lamp

circuit alone isolated from its operation in the power control system. When the lens cap is depressed, voltage is supplied to the lamp circuit. After a one second delay the light should go on.

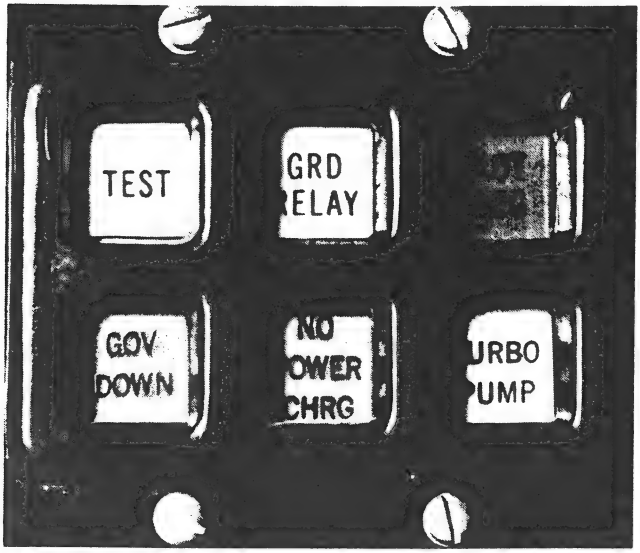


Fig.2-18 No. 1 Indicator Light Panel

Indicator Light Panel No. 1.

Test Light This light comes on when circuits are set up for circuit check or load testing, on locomotive units equipped for self loading. On the locomotive dynamic braking resistor grids, the circuit set up is automatic when the reserver handle is centered and a rotary snap switch located on a test panel in the circuit breaker compartment is properly positioned.

Caution

Do not perform automatic loading on a unit moving in a consist or a train. Do not return test switch to **Normal** position while operating under load

GRD (Ground) Relay Light This white light indicates that an electrical path to ground has occurred, or that a group of diodes in the main generator has failed. When the light comes on and the alarm sounds, the operator should wait 10 seconds, then press the ground reset button located on the control stand. Power will then reapply. It is not necessary to isolate the unit, nor is it necessary to have the throttle in idle while pressing the button.

When the high voltage ground/fault alarm occurs for the fourth time after using the ground reset button three times, the affected unit should be isolated.

Caution

Always report ground failure light indications to proper maintenance personnel.

Hot Engine Light This red light operates in conjunction with the alarm bell to warn the operator that engine cooling water has reached an excessive temperature. When the red light is on, engine speed and power are automatically reduced until the hot engine condition is corrected. If the cooling system has failed, a hot lubricating oil detector will shut the engine down before serious engine damage occurs. If hot engine shutdown occurs, do not attempt to restart the engine. Report shutdown circumstances to authorized maintenance personnel.

Governor Shutdown Light This amber light comes on when the engine governor has shut the engine down for one of the following reasons:

1. Low lubricating oil pressure.
2. Hot engine oil.
3. Low cooling water pressure.

4. Crankcase (oil pan) overpressure.

Refer to Safety Devices paragraph under Engineroom Equipment Section for information concerning safety devices.

No Power Light This blue light will come on and the alarm bell will sound whenever D14 alternator output stops - normally at engine shutdown. The indication can also be caused by true D14 failure or failure of the auxiliary generator. A tripped AC Control circuit breaker will also bring about the indication. In each case the locomotive will fail to deliver power.

Turbo. (Charger) Pump Light This white light will come on as soon as the main battery switch and turbo charger lube pump circuit breaker are closed. It indicates that the turbocharger auxiliary lube oil pump is supplying lube oil to the turbocharger. It will remain on for approximately 35 minutes after the main battery switch is closed. When the fuel prime/engine start switch is operated after the 35 minute period, the time cycle is again re-established and the light remains on for another 35 minutes.

The light will also come on and remain on for approximately 35 minutes after the engine is stopped. It provides an indication that the auxiliary lube oil pump is supplying oil to cool the turbocharger bearings.

If the power supply to the turbo lube pump motor is open, the engine will not start and the light will fail to come on when a starting attempt is made.

Indicator Light Panel No. 2

Fil (Filter) Motor Trip Light This white light, marked Fil Motor Trip, indicates that the carbody inertial filter exhaust blower motor is not receiving power. Check for a tripped filter blower motor cir-

cuit breaker on the circuit breaker panel. If the breaker will not reset, operation may continue to the nearest maintenance point where the condition should be reported and corrected.

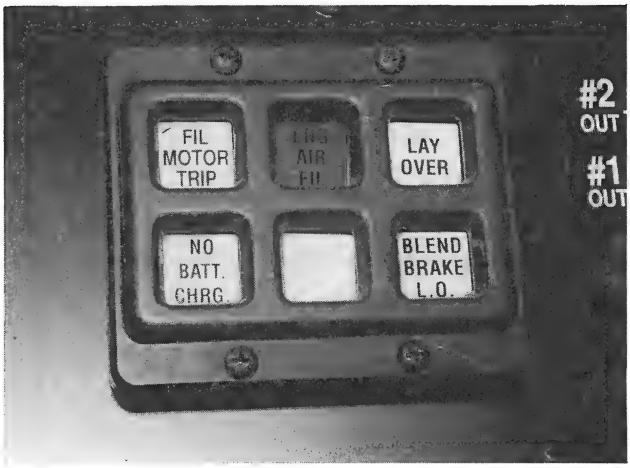


Fig.2-19 Indicator Light Panel No.2

Engine Air FIL (Filter) Light This green light will come on when the air pressure differential between the ambient side of the inertial and engine filter elements, and the pressure at the turbocharger inlet reaches 356 mm (14" water). This light indicates excessive restriction of air to the engine. This condition should be reported at the next maintenance station.

Layover Light This white light comes on when the engine is shut down with the layover power switch in the **Normal** protection position, indicating that the layover circuits will operate if all appropriate circuit breakers are closed.

No Battery Charge Light This white light will come on and the alarm bell will sound whenever the 18Kw auxiliary generator output stops - nor-

mally at engine shutdown. The indication can also be caused by a true 18Kw auxiliary generator failure.

If the light does not come on after engine shutdown, it would indicate a shorted battery charging assembly.

Blend Brake L.O. Light This light indicates that the blended brake system has been locked out either by the blended and dynamic brake cut-out switch in the cut-out position or by a signal from the DA Card.

Traction Motor Cutout Switch

The traction motor cut-out switch, Fig.2-17, operates to electrically isolate a defective traction motor. This permits operation with the remaining good motors. The power control system automatically limits power to prevent overloading the operative motors. The isolated motor will continue to rotate as the train moves.

To operate motor cut out switch, it is first necessary to place isolation switch on the engine control panel in **Isolate** position. The switch is then pressed in and turned to cut out the desired motor.

Warning

Make certain that all wheels rotate freely before operating with a motor cut out.

Dynamic And Blended Brake Cutout Switch

When this switch is placed in the **Cutout** position, the individual unit will not operate in blended braking. It will, however, continue to operate under power with normal air braking. The switch can be used to limit the number of units in a consist that will operate in blended braking, or it may be used to cut out a unit that is defective blended braking,

yet allow it to operate under power.

Warning

When dynamic and blended brake cut-out switch is put in the **Cutout** position, anticipated stopping distances with the locomotive automatic brake valve are considerably lengthened.

E.P. Brake Cutout Switch

This switch activates or nullifies the operation of the electro-pneumatic braking system.

Light Switches

Light switches are provided on this panel to operate:

a. Front Number Lights

b. Front Marker Lights

c. Rear Marker Lights

d. Platform Lights

e. Engine Room Lights

f. Rear Number Lights

Emergency Fuel Cutoff And Engine Stop Pushbutton

This pushbutton activates immediate shutdown of the main propulsion engine and the HEP plant engine. The pushbutton should be held in for a few seconds to assure complete shutdown of both engines.

Layover Protection Switch

This switch sets up the circuit to operate the layover cab heater when the engine is shut down during freezing weather. The switch should always be in the **Normal** position when the locomotive is hooked up to external power during layover.

Note

Both layover heater circuit breakers located on the LOC control box in the short hood must be placed in the **On** positions.

Main Engine Stop Button

This button, Fig 2-17, can be pressed in to stop the propulsion engine. The stop button should be held in for a few seconds to assure complete engine shutdown. The isolation switch should be placed in the **Stop** position prior to pushing the main engine stop button. Pressing this button does not affect operation of the HEP engine.

Isolation Switch

The isolation switch has two positions, one labeled Start/Stop/Isolate, the other labeled Run. The functions of these two positions are as follows:

Start/Stop/Isolate Position The isolation switch is placed in this position whenever the diesel engine is to be started. The start switch is effective only when the isolation switch is in this position.

This position is also used to isolate the unit, and when isolated, the unit will not develop power or respond to the controls. In this event the engine will run at low idle speed regardless of throttle position. This position will also silence the alarm bell in the event of a no power or governor down alarm. It will not, however, stop the alarm in the event of a hot engine.

The locomotive is equipped with a remote traction motor cut-out switch feature and the isolation switch must be placed in the **Isolate** position before the cut-out switch can be operated.

Run Position After the engine has been started, the unit can be placed "on the line" by moving the isolation switch to the **Run** position. The unit will

then respond to control and will develop power in normal operation.

Door Mode Switch

Position this switch according to the train consist. If all Comet 3 equipment is in the train consist, position the switch in **up** position.

If the train consist is a mixture of Comet 1 and Comet 2 equipment, place the switch in the **down** position.

For light locomotive movement, the switch may remain in the position it was prior to uncoupling.

Conductor's Buzzer

This buzzer is connected to the communication trainline and will sound to indicate a signal from the conductor in the passenger cars. The buzzer will also sound when the conductor's signal pushbuttons on the control stands are pressed.

End Door By-Pass Switch

When this sealed switch is placed in the By-pass position, it will override a faulty end door circuitry or signal and allows locomotive power and an increase in engine speeds above idle.

Center Door By-Pass Switch

When this sealed switch is placed in the By-pass position, it will override a faulty center door circuitry or signal and allows locomotive power and an increase in engine speeds above idle.

No Motion By-Pass Switch

When this sealed switch is placed in the By-pass position, it will override a faulty no motion circuit on the locomotive and provides a no motion signal to the passenger cars when the generator field switch on the control stand is in the **Off** position.

CMR By-Pass Switch

This switch by-passes a faulty isolation pressure

switch and provides pick up of one of the cab make-up relays.

Front Position - Use this position when using No. 1 control stand and traveling in a forward (short hood) direction.

Rear Position - Use this position when using No. 2 control stand and traveling in a rear (long hood) direction.

Note

These by-pass switches are sealed in a Normal operating condition. Use the switch only as an emergency measure and report the circumstances to proper maintenance personnel.

Circuit Breaker Panels

The three circuit breaker panels contain circuit breakers and controls used to protect engine, control systems, lights and miscellaneous devices that are used as conditions require. These circuit breakers can be operated as switches, but also will automatically trip open when overload occurs.

No. 1 Circuit Breaker Panel

This panel contains circuit breakers that protect customer requested extra equipment. The No. 1 circuit breaker panel, Fig. 2-20-A, has provisions for twelve circuit breakers. The following paragraphs contain a brief description of typical circuit breakers on this panel.l

Aux. Cab Htr.Breakers These breakers protect the left and right auxiliary cab heaters. Heat control is provided by switches located on the control stand or at the heater.

Air Dryer Breaker This breaker provides power to the air dryer in the compressed air system and should be turned on when air compressor is operational.

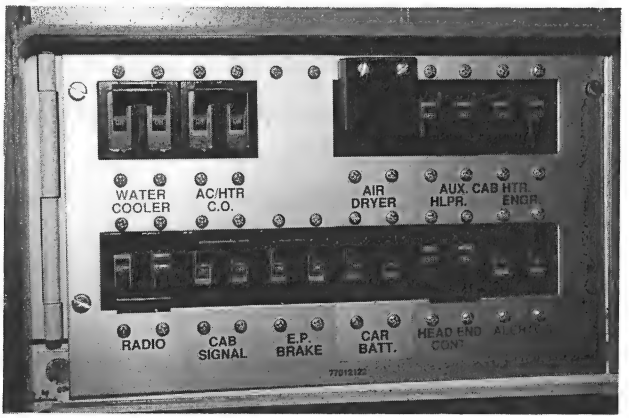


Fig. 2-20-A Typical No. 1 Circuit Breaker Panel

A.C./Htr. (Air Conditioner/Heater) Cutout Breaker This breaker provides power to the automatic contactor which eliminates excessive power load on the engine at low idle. The contactor will automatically shut down the auxiliary cab heaters and the helper's cab heater when the locomotive engine is left at low idle.

Water Cooler Breaker This circuit breaker protects the circuit to the electric water cooler.

Alerter Circuit Breaker This circuit breaker protects the alertness control circuits.

Head End Control Breaker This breaker provides power to the control circuitry on the head end electric power plant.

Car Battery Breaker This circuit breaker protects the communication trainline circuits used on the locomotive. This breaker receives its feed from the passenger cars through the communication trainline.

E.P. (Electro-Pneumatic) Brake Breaker This breaker provides power to the trainlines feeding the magnet valves which actuate the electric pneu-

matic brake system on the locomotive and passenger cars.

Cab Signal Breaker This circuit breaker protects the cab signal circuits.

Radio Breaker This circuit breaker protects circuits that supply the radio.

Note

The radio breaker must be turned on in order for the public address/intercommunication system to operate.

No. 2 Circuit Breaker Panel

The No. 2 circuit breaker panel, Fig. 2-20-B, contains circuit breakers and switches that protect basic locomotive equipment and control systems. The panel is divided into three sections. The shaded middle section indicates breakers required to be **On** for locomotive operation. Breakers in the unshaded section are used as conditions require.

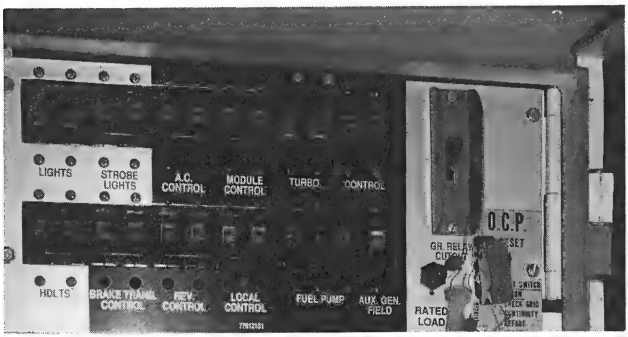


Fig. 2-20-B Typical No. 2 Circuit Breaker Panel

Control Circuit Breaker This circuit breaker sets up the fuel pump and control circuits for engine starting. Once the engine is running, power is sup-

plied through this breaker from the auxiliary generator to maintain operating control.

Turbo Circuit Breaker This circuit breaker must be in the **On** position to start the engine and operate the turbocharger auxiliary lube oil pump. It must remain in the on position to provide auxiliary lubrication to the turbocharger at engine start and after the engine is shut down.

Module Control Circuit Breaker This circuit breaker protects the local control power circuit supplying the electrical control modules and miscellaneous control system devices.

AC Control Circuit Breaker The companion alternator is the power supply for various excitation and wheel slip control devices. This breaker is employed to protect that circuitry. The No AC Voltage relay NVR is also located in this circuit. If the breaker trips during locomotive operation, a No Power/Chrg. alarm will be given.

Strobe Lts. (Lights) Breaker This breaker protects the cab mounted strobe lights.

Lights Breaker This breaker must be on to supply power switches that control miscellaneous locomotive lights.

Aux. Gen. Field Circuit Breaker The field excitation circuit of the auxiliary generator is protected by this breaker. In the event that this breaker trips, it stops auxiliary generator output to the low voltage system and also stops fuel pump operation. An alternator failure (no battery charge and no power) alarm would then occur. The engine will go to idle speed and then stop from lack of fuel.

Unlike other breakers on the panel that trip to the full **Off** position, this breaker will trip to the center position. After a period for cooling, the breaker must be placed in the full **Off** position before

resetting to the **On** position.

Fuel Pump Circuit Breaker This three pole breaker protects the fuel pump motor circuit. A fuel filter bypass valve is provided to prevent overloading the fuel pump motor if the fuel filter becomes clogged.

Local Control Circuit Breaker This circuit breaker establishes "local" power from the auxiliary generator to operate heavy duty switchgear and various control devices.

Rev Control Circuit Breaker This double pole breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches that control the direction of current flow through the traction motor fields and thus control the direction of locomotive travel. Since control power is required to move the RV transfer switchgear from any position to any other position, the Rev Control breaker must be closed for power transfer to take place. An open Rev Control breaker does not prevent switchgear already in position from conducting traction motor current, but interlocking prevents an operating setup in conflict with transfer switch position.

Brake Trans. Control Circuit Breaker This double pole breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches that control the motor field and armature connections for either dynamic braking or power operation. Since control power is required to move the transfer switchgear from any position to any other position, the breaker must be closed for power transfer to take place. An open breaker does not prevent switchgear that is already in position from conducting traction motor current, but interlocking prevents an operating setup in conflict with transfer switch position.

Hdlts. (Headlights) Circuit Breaker This breaker protects the headlight circuits.

Ground Relay Cutout Switch The purpose of the ground relay cut-out switch is to disconnect the ground relay during certain shop maintenance inspections. It must always be kept closed in normal operation. When this switch is open, it prevents excitation of the main generator and throttle response of the diesel engine in addition to cutting out the ground relay.

Open Grid Circuit Reset Button This button is used to reset the open grid circuit protective relay (OCP) on units equipped with extended range dynamic braking. If an open circuit occurs in the dynamic braking grids or cabling, the OCP relay will pick up, locking out dynamic braking.

RL (Rated Load) Switch This pushbutton switch is provided for use during load test. Each time the RL switch is pressed and released with the throttle in Run 8 position, it provides a rated load to be applied to the locomotive grids and an increase in excitation for a maximum of five minutes.

Caution

Rated load should not be applied for more than 10 minutes out of any consecutive 60 minute period. A longer period would probably result in damage to the main generator due to excessive excitation applied to the main generator field or cause damage to the dynamic brake grid resistors.

No. 3 Circuit Breaker Panel

The No. 3 circuit breaker panel, Fig. 2-20-C, has provisions for five circuit breakers. The panel also contains a sealed section. This section contains a test panel intended for use by maintenance personnel during maintenance and testing proce-

dures. A 74 volt receptacle and fuse test switch are also part of this panel.

The circuit breaker portion of the panel is divided into sections. Breakers in the shaded section must be **On** (lever up) during locomotive operation. Breakers in the unshaded section are to be used as conditions require.

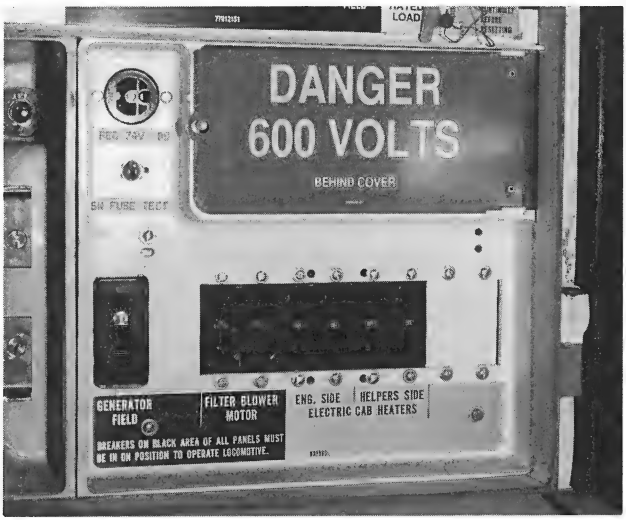


Fig. 2-20-C Typical No. 3 Circuit Breaker Panel

Generator Field The main generator receives excitation current through silicon controlled rectifier assembly SC from the companion alternator. This breaker is provided to protect SCR and both generators as well as associated circuitry.

Note

Unlike other breakers on the panel that trip to the full off position, the generator field circuit breaker trips to the center position. To reset this breaker, wait for the generator field to cool, pull the lever

down to the full off position, then raise it to the on position.

Filter Blower Motor This breaker protects the inertial filter blower motor circuit. The blower is used to evacuate dirt-loaded air from the central air compartment inertial filters. The **Filt. Motor Trip** light on the engine control panel will come on if this breaker trips open or is inadvertently left in the off position. If tripped open, operation may continue until the locomotive reaches the nearest maintenance point.

Electric Cab Heaters

Eng. Side

Protects circuits to the cab heater at the operator's station.

Helpers Side

Protects circuits to the cab heater at the helper's side of the cab.

Fuse Test Switch Refer to Fuse Test Equipment paragraph under the Fuse And Switch Panel section.

74 Volt Receptacle This receptacle makes 74 volts DC available for maintenance or testing purposes. Power is supplied to the receptacle when the main battery switch and the Lights circuit breaker are closed.

Fuse And Switch Panel

The fuse and switch panel, Fig. 2-21, contains the equipment described in the following paragraphs.

Note

There is no companion alternator field fuse. If a fault occurs in this circuit, no power - no battery charge - filter motor trip messages will appear on indicator light panels, accompanied by an audible alarm.

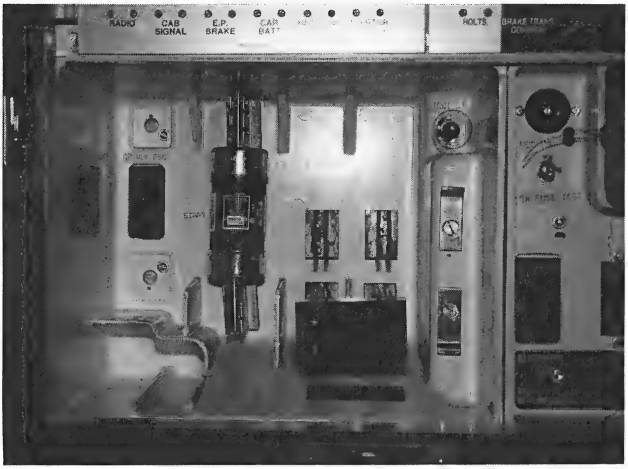


Fig. 2-21 Fuse and Switch Panel

Auxiliary Generator Circuit Breaker This breaker connects the auxiliary generator to the low voltage system. It protects against excessive current demands.

Note

Unlike other breakers that trip to the full off position, this breaker will trip to the center position. To reset this breaker, pull the lever down to the full off position, then raise it to the on position.

Starting Fuse The starting fuse is in use only during the period that the diesel engine is actually being started. At this time, battery current flows through the fuse and starting contactor to the starting motors.

Although this fuse should be in good condition and always left in place, it has no effect on locomotive operation other than for engine starting. A defective fuse can be detected when attempting to start the engine, since at that time (even though

the starting contactors close) the starting circuit is open.

Caution

This locomotive is equipped with series connected starting motors which require a 400 ampere starting fuse. Observe fuse panel marking. Do not use an incorrectly rated fuse.

Battery Knife Switch The large double-pole single-throw knife switch at the lower portion of the fuse panel is the battery switch. It is used to connect the battery to the locomotive low voltage system and should be kept closed at all times during operation.

This switch may be opened during certain shop maintenance procedures and in instances where the engine is shut down and the locomotive taken out of service for an extended layover. This will prevent the battery from being discharged in the event the lights or other low voltage devices are inadvertently left operating during the layover.

Fuse Test Equipment A pair of fuse test blocks and a test light are installed on the fuse and switch panel. A test light toggle switch is located just to the right and slightly above the fuse test blocks, on the No. 3 circuit breaker panel. Fuses may be readily tested as follows. Move test light switch to the on position to make sure the fuse test light is not burned out. Move test light switch to the off position to turn light off. Place fuse to be tested across the test blocks so that the metal ends of the fuse are in firm contact with the blocks. If the fuse is good the light will come on.

It is always advisable to test fuses before installation. Always isolate the circuits in question by opening their switches before changing or replacing fuses.

Spotter Circuit

The spotter circuit is used to move the locomotive short distances. Battery voltage is applied to two traction motors in series by use of a pendant control (receptacle is located on center main cabinet door). **Only use when the locomotive is dead, with main reservoir air pressure at 100 PSI or more and with the battery switch closed.**

Remote Head End Power Control Panel

This panel, Fig. 2-22, is located on the upper middle door of the electrical cabinet. The panel permits the operator to monitor and control the power supply for the attendant passenger cars from the locomotive cab.

Note

The indicator lights on this panel are equipped with a push-to-test feature. This permits testing of the lamp circuit alone, isolated from its operation in the power generation system. When the lens cover is depressed, voltage is supplied to the lamp circuit. After a short delay, the light should go on.

Contactor Closed Light

This green light is normally on during operation of the electrical power feed to the passenger cars. The light indicates that A.C. power is on-line to the trailing cars.

Contactor Open Light

This red light indicates that the main contactor which feeds power to the trailing cars is open. The light will be on during startup of the HEP system when the engine is warming up and before the AC Power On button is pushed.

480V External Feed Light

This yellow light indicates that there is an external

Fig. 2-22 HEP Control Panel

feed of 480 V AC on the HEP trainline. This feed may be from either wayside power or another HEP unit on line in the locomotive consist.

Hot Engine Light

This red light will come on when engine water temperature rises above 210 F. The main contactor

will automatically open in this situation, and the engine and cooling fan will continue to operate. If the water temperature continues to rise, the engine will automatically be shut down when the water temperature reaches 223 F.

Low Oil Pressure Light

This amber light will come on when the engine has shut down due to low oil pressure. It is mandatory to check the lube oil level when this occurs.

Low Water Level Light

This white light indicates that the level of cooling water is low in the HEP diesel engine cooling water expansion tank.

Remote HEP Panel Meter AC Voltmeter

This meter registers the voltage being produced by the alternator. During start-up and when the engine is in the **Idle** mode, voltage will be in the range of 250 volts. When the HEP engine is in the **Run** mode, this meter should indicate 480 volts.

Engine Failure Light

This blue light indicates that the HEP diesel engine has shut down. Check the indicating lights on the **engine room relay cabinet** to determine the cause of the shutdown.

Ground Fault Light

This white light indicates that a ground fault has occurred. The Ground Fault Reset button is located on the lower right hand corner of the HEP Relay Cabinet in the engine room. If the fault fails to clear after the reset button is pushed three times, shut down the system and report the failure to the mechanical department.

Phase Light

This white light indicates that proper voltage is being produced by the alternator. The light will

burn when the engine is operating in the **Run** mode (1800 RPM) and the alternator is producing 480 V AC.

Trainline Complete Lights

These amber lights will come on to indicate that the trainline feed system is complete. The Left and Right lights indicate the left or right power loops are properly connected between the locomotive and train and the power circuit is ready to receive power from the locomotive HEP unit.

Remote HEP Panel Switches

Stop Push Button Under normal operating circumstances, this button should not be pushed until the proper engine shutdown routine has been accomplished. The proper shutdown procedure is to push the **AC Power Off** button, set the **Idle Run** Switch on **Idle** and wait until the engine cools down (no longer than 15 minutes) prior to pushing this button. To restart the unit, initiate the start-up procedure from the begin-ing. To accomplish engine shutdown, the button should be held in for a couple of seconds. In emergency situations this red push button will shut down the HEP plant power generation unit without affecting the main diesel propulsion engine.

Note

In some cases it is desirable to shut down both the HEP and the Main drive engines simultaneously which can be accomplished by pressing one of the three locomotive Emergency Fuel Cutoff Switches.

Start Push Button The HEP engine can be started from the remote panel if the various switches on the HEP relay cabinet are positioned properly (*) and it is known to be safe to the equipment to do so.

* See "Operation" section, Starting HEP Plant; a similar proceedure should be followed.

AC Power On Switch This button is used to close the main contactor which feeds power to the passenger cars. The button should only be pressed after the Idle Run switch has been placed in the **Run** position and the Phase light is indicating that the alternator is operating.

Idle Run Switch This switch controls the speed of the generator engine. The switch should be set in the **Idle** position at start up. The switch should then be moved to the **Run** position after sufficient time has elapsed to allow the engine to warm up.

Voltmeter Switch This switch selects which two generator phases that the voltmeter is across. The voltage between these two phases is displayed on the AC Voltmeter.

Fuel Pump Aux.(Auxillary) Reset Switch This button is used to reset the HEP FPCA relay prior to engine start. If not reset following a normal or emergency shutdown, it will not be possible to re-start the HEP engine.

Alarm Reset Switch This button turns off the alarm lights following automatic reset of the warning devices.

Ground Fault Reset Button This button resets the ground relay. If the button is pushed three times and continues to fault, the system should be shut down and reported at the next maintenance station.

Trainline Complete Mode Switch This switch selects HEP trainline safety loop circuit using either Pin #1 or Pin #3 on the HEP trainline jumper cables. Pin #1 is used when connected to Amtrak passenger coaches and Pin #3 is used when connected to New Jersey Transit coaches. The safety loop circuit

prevents the 480V AC HEP power from being applied to the HEP power trainline until all HEP power jumper cables are connected properly.

AC Power Off Switch This button is used to open the main feed contactor and discontinue power feed to the passenger cars.

Trainline Set Up Switch This switch is used to establish the proper electrical system that is compatible with the trailing cars or conditions of operation. The switch has three operating positions which function as follows:

Long Hood Coupled

This is the normally used mode for trailing passenger cars with a single GP40PH-2 locomotive, the short nose being the normal forward end of the locomotive.

Feed Thru Coupled

This position is used when the locomotive is part of a consist and another unit's HEP plant is being used to supply power to the trailing passenger cars. In this mode, the locomotive is as a circuit passing power through to the passenger cars while its HEP plant remains isolated.

Short Hood Coupled

This position is used when passenger cars are trailed from the short nose of the locomotive.

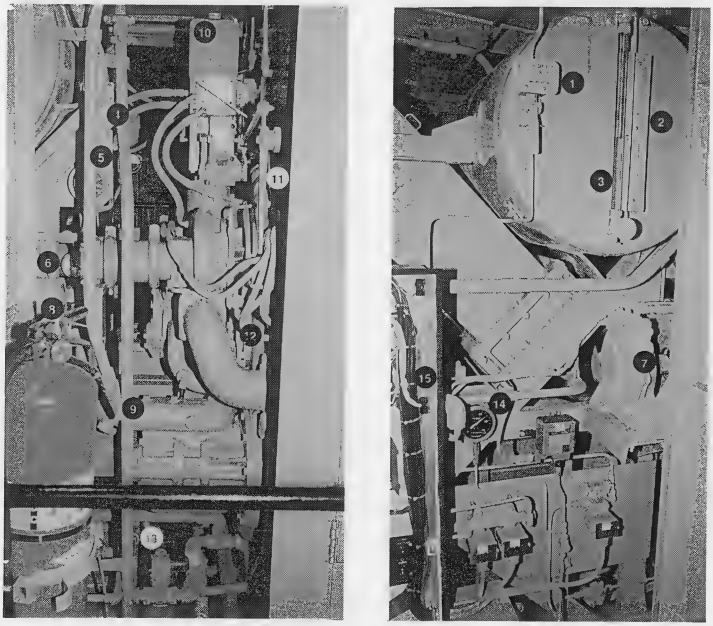
Engineroom Equipment

Engine starting and monitoring equipment is located in the engine room as shown in Fig. 2-23.

Engine Starting Controls

Note

Refer to Operation section for complete inspection and starting instructions.



1. Manual Shutter Control Valve
2. Water Level Instructon Plate
3. Water Level Sight Gauge
4. Fuel Oil Filter Bypass Gauge
5. Lube Oil Pressure Gauge
6. Water Temperature Gauge
7. Load Regulator
8. Fuel Prime/Engine Start Switch (See Fig. 2-24)
9. Water Filler
10. Governor
11. Injector Rack Manual Control Level
12. Dual Differential Low Water/ Crankcase Oil Pressure Detector (See Fig. 2-26)
13. Water Tank Overflow
14. Air Pressure Gauge
15. AC Cabinet

Fig. 2-23 Engineroom Equipment

Fuel Prime/Engine Start (FP/ES) Switch

This three position rotary switch, Fig. 2-24, is located in a junction box mounted on the equipment rack. The functions of the three positions are as follows:

1. Fuel Prime Position - This position is used to prime the engine with fuel prior to starting. In this position, the fuel pump motor is energized with battery power, but the engine will not crank. Additional contacts energize the auxiliary turbocharger lube oil pump motor, ensuring a supply of lube oil under pressure to the turbocharger bearings during startup.

2. Engine Start Position - This position is used to supply power from the batteries to the starting motors. The starter motor pinion gear engages with the engine ring gear which causes the engine to crank until FP/ES switch is released.

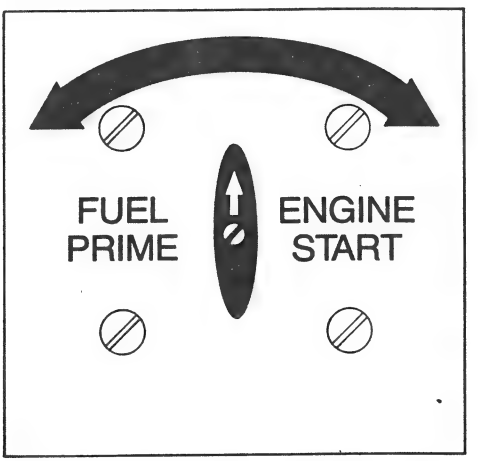


Fig. 2-24 Fuel Prime/Engine Start (FP/ES) Switch

3. Centered (Off) Position - The FP/ES switch is spring loaded to return to this position when re-

leased. Contacts that are normally closed in this position supply power to the fuel pump motor from the auxiliary generator when the engine is running.

Injector Rack Manual Control Lever (Layshaft)

This engine mounted hand operated lever, Fig. 2-23, may be used to manually operate the injector racks. It is primarily used to position the injector racks during engine cranking, thereby providing an immediate supply of fuel to the cylinders.

Caution

This unit is equipped with an engine purge control system; do not push injector control lever until engine has cranked for 6 seconds.

Monitoring Devices

The following devices monitor certain locomotive systems. They provide visual indication as to the condition of the systems.

Each device represents a system which could cause the engine to shut down. Periodic checks of these systems will alert the operator to an impending failure. Report all abnormal readings to proper maintenance personnel.

Water Level Instruction Plate

This plate is mounted next to a sight gauge on the water tank. To check water level, open the valve handle at bottom of gauge. Read water level using the instruction plate as a guide, then close valve. To avoid false readings, drain the gauge using a small drain cock at bottom of gauge.

Lube Oil Pressure Gauge

This gauge provides a ready reference indicating lube oil pressure. During normal operation lube oil

pressure will increase as diesel engine speed increases.

Water Temperature Gauge

Engine inlet water temperature may be readily checked using this gauge. The gauge is color coded to indicate **Cold** (blue), **Normal** (green), and **Hot** (red).

Air Pressure Gauge

This gauge indicates No. 1 main air reservoir pressure.

Safety Devices

A mechanism to detect low engine lubricating oil pressure is built into the engine governor. Under normal operating conditions, engine lubricating oil, under pressure, is applied to the mechanism. Should oil pressure drop to a dangerously low level, a small plunger, Fig. 2-25, will pop out the side of the governor body, indicating that the mechanism has tripped. The **Gov Down** light will come on and the engine will shut down in approximately 2 seconds if operating in throttle positions 2 and above. If at idle, a time delay before shutdown is built into the governor.

The locomotive is also equipped with devices, Fig. 2-26, which will detect low cooling water pressure at the left and right side water pumps as well as excessive crankcase pressure. When activated, the devices release oil pressure from the line leading to the low oil pressure mechanism in the governor, causing engine shutdown.

If necessary to determine cause of shutdown, check the crankcase pressure and differential low water pressure detecting devices for protruding reset buttons. A protruding button indicates the device that has caused engine shutdown. If crankcase pressure or low water pressure are not the cause, then the engine was shut down by either

the hot oil detector or a true oil pressure failure.

Warning

When it is determined that the crankcase pressure detector has tripped, make no further engine roo inspections. **Do not attempt to restart the e gine.** Isolate the unit. Drain the cooling system in accordance with New Jersey Transit regulations if freezing conditions are possible.

If neither the crankcase pressure nor the low water pressure detector has tripped, and engine oil lev is satisfactory with a hot engine condition appar ent, do not attempt to restart the engine. Report engine shutdown circumstances to maintenance personnel.

Overspeed Mechanism

An overspeed mechanism is provided to stop injection of fuel into the cylinders should engine speed become excessive. This will result in immediate shutdown of the engine and a **No Power/ Chrg.** alarm.

To reset mechanism, move trip reset lever, Fig. 2-25, counterclockwise until it resets.

Miscellaneous Devices

Manual Shutter Control Valve

During normal operation, this valve is in the **Operation** position. In this position, the cooling control system automatically opens and closes the cooling system shutters, depending on conditio .

In any emergency, the shutters may be opened manually by moving the shutter control valve to the **Test** position.

HEP Plant Relay Cabinet

This cabinet, Fig. 2-27, contains the indicating

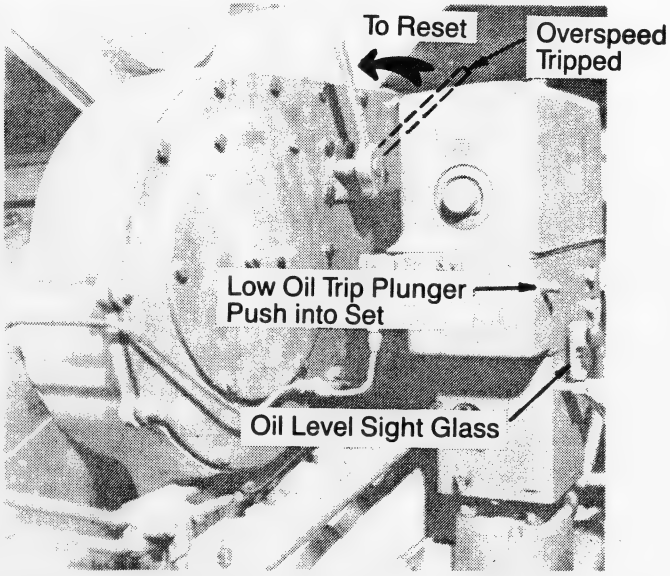


Fig. 2-25 Governor Low Oil Trip Plunger and Engine Overspeed Trip Reset Lever

lights, switches and gauges for operation of the head end power unit which feeds electric power to the passenger cars.

Relay Cabinet Meters

This panel displays meters which monitor the operating characteristics of the power generating unit.

AC Voltmeter

This meter registers the voltage being produced by the alternator. During start-up and when the engine is in the **Idle** mode, voltage will be in the range of 250 volts. When the HEP engine is in the **Run** mode, this meter should indicate 480 volts.

Frequency Meter

This meter monitors the frequency being produced

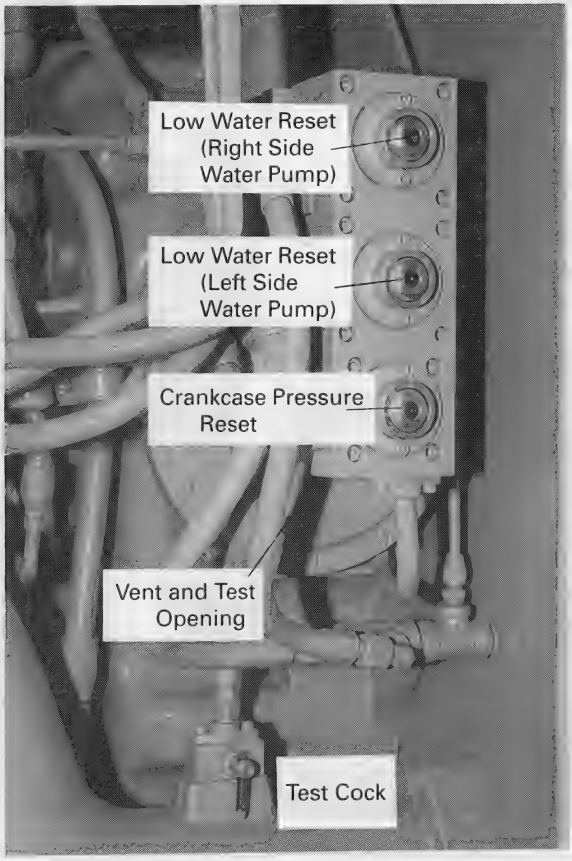


Fig. 2-26 Dual Differential Low Water/Crankcase Oil Pressure Detector

by the HEP plant. The normal frequency produced when the engine is in the Run mode (1800 RPM) is 60 Hz.

AC Ammeter

This meter displays the amperage per phase drawn by the passenger cars; the value may be used as a guide to the amount of power being consumed by the trailing cars.

Fig. 2-27 HEP Relay Cabinet

DC Voltmeter

This meter indicates the voltage of the locomotive battery. A normal reading of 64 volts indicates that the battery is properly charged for starting the engine.

Elapsed Time Meter

This meter indicates the number of operating hours on the engine.

Panel Indicating Lights

Operating faults in the alternator, the trainline power feed loop and some engine faults will automatically open the main contactor and an indicator light will come on to describe the nature of the fault. Some engine faults will automatically shut down the engine and the indicator lights will describe the cause of the shutdown.

Note

The indicator lights on this panel are equipped with a push-to-test feature. This permits testing of the lamp circuit alone, isolated from its operation in the power generation system. When the lens cover is depressed, voltage is supplied to the lamp circuit. After a short delay, the light should go on. The test feature in the Phase Lights will only work when the HEP plant is running.

Phase Lights

These two white lights indicate that proper voltage is being produced by the alternator. During start-up the two lights will be dim when the generator diesel engine is at idle speed and the alternator is producing approximately 250V AC. The lights will burn brightly when the engine is operating in the **Run** mode (1800 RPM) and the alternator is producing 480 V AC.

Contactor Closed Light

This green light is normally on during operation of the electrical power feed to the passenger cars. The light indicates that AC power is on line to the cars.

Contactor Open Light

This red light indicates that the main contactor which feeds the power distribution to the trailing cars is open. The light will be on during start-up of the HEP system while the engine is warming up and before the AC **Power On** button is pushed.

High Water Temperature Light

This red light will come on when engine water temperature rises above 210 F. The Main Contactor will automatically open in this situation, and the engine and cooling fan will continue to operate. If the water temperature continues to rise, the engine will automatically be shut down when the water temperature reaches 223 F.

Low Oil Pressure Light

This amber light will come on when the engine has shut down due to low oil pressure. It is mandatory to check the lube oil level when this occurs.

Ground Fault Light

This white light indicates that a ground fault has occurred. The Ground Fault Reset button is located on the lower right hand corner of this panel.

Engine Overspeed Light

This white light will come on if the main contactor has opened because the engine is exceeding the 1800 RPM for Run mode.

Low Water Level Light

This white light indicates that the level of cooling

water is low in the HEP diesel engine cooling water expansion tank.

Trainline Complete Lights

These amber lights will come on to indicate that the trainline feed system is complete. The left and right lights indicate the left or right power loops are properly connected between the locomotive and train, and the power circuit is ready to receive power from the locomotive HEP unit.

Over-Current Light

This blue light indicates that the Main Contactor has opened because the alternator is being overloaded by demand from the trailing cars.

Over/Under Frequency Light

This red light will come on to indicate that the Main Contactor has opened because the alternator is operating over or under the proper frequency.

Over/Under Voltage Light

This blue light indicates the Main Contactor has opened because the unit is producing an incorrect voltage.

Relay Panel Switches

AC Power On Switch

This button is used to close the main contactor which feeds power to the passenger cars. The button should only be pressed after the **Idle Run** switch has been placed in the **Run** position, the **Phase** lights are burning brightly, indicating that the alternator is producing 480 volts, and the left and right trainline complete lights are lit, indicating that all 480V HEP receptacles are properly installed.

Start Push Button

This green button is the start button for the HEP

unit diesel engine. Make sure the proper starting procedures have been followed before pressing this button.

Idle-Run Switch

This switch controls the speed of the generator engine. The switch should be set in the Idle position at start up. The switch should then be moved to the Run position after sufficient time has elapsed to allow the engine to warm up.

Stop Push Button

Under normal operating circumstance this button should not be pushed until the proper engine shutdown routine has been accomplished. The proper shutdown procedure is to push the **AC Power Off** button, set the **Idle Run** Switch on **Idle** and wait until the engine cools down prior to pushing this button. To restart the unit, initiate the start-up procedure from the beginning. To accomplish engine shutdown, the button should be held in for a couple of seconds. In emergency situations this red push button will shut down the HEP plant power generation unit without affecting the main diesel propulsion engine.

Note

In some cases it is desirable to shut down both the HEP and the Main drive engines simultaneously which can be accomplished by pressing one of the three locomotive **Emergency Fuel Cutoff Switches**.

AC Power Off Switch

This button is used to open the main feed contactor and discontinue power feed to the passenger cars.

Fuel Pump Aux. (Auxiliary) Reset Switch

This button is used to reset the HEP FPCA relay prior to engine start. If not reset following a normal or emergency shutdown, it will not be possible to restart the HEP engine.

Alarm Reset Switch

This button turns off the alarm lights following automatic reset of the warning devices.

Ground Fault Reset Button

This button resets the ground relay. If the button is pushed three times and continues to fault, the system should be shut down and reported at the next maintenance station.

Circuit Breakers

There are three circuit breakers located on the bottom of this panel. They should be turned to the **up** or **On** position prior to engine start and **Off** or **down** when the HEP plant is shut down. The circuit breakers protect the circuits in the relay panel.

Battery - CB1

This breaker protects the main battery feed to the HEP control circuits.

Instrument Power Output - CB3

This breaker protects the output from Instrumentation Potential Transformers PT1 and PT2 which feed the Frequency Meter, AC Voltmeter, Phase Lights and the Over/Under Frequency Relay.

Voltage Regulator - CB5

This breaker protects the circuit feeding the HEP generator voltage regulator.

Air Conditioner - CB11

This breaker protects the circuits to the air condi-

tioner in the main operator

HEP Plant High Voltage Cabinet

This cabinet, Fig. 2-28, is where the power output of the alternator is distributed to the HEP trainline at the proper end of the locomotive to feed the trailing passenger cars. Various switches and circuit breakers are used to distribute power and to protect the system. The layover power system is also controlled from equipment in this cabinet.

Cooling Fan Motor - CB6

This circuit breaker is used to protect the cooling fan motor. The breaker must be in the up **(On)** position during operation of the HEP plant.

1. Cooling Fan Motor (CB6)
2. Main Engine KIM (CB7)
3. A.C. Disconnect Motor (CB9)
4. Ground Fault Test Switch
5. Instr. Power Input (CB2)
6. Voltage Power Input (CB4)
7. Engine Hot Start (CB8)
8. Battery Charger (CB10)
9. Air Conditioner (CB11)

Fig. 2-28 HEP High Voltage Cabinet

Main Engine KIM Heater - CB7

This breaker connects the 480 V HEP trainline to the main engine KIM layover system.

AC Disconnect Motor - CB9

This breaker protects the circuits to the motor of the AC Disconnect Switch that isolates the HEP receptacles at the front of the locomotive. This breaker must be On during HEP plant operation with the Trainline Setup Switch in the **Short Hood Coupled** or **Feed Thru** position.

Ground Fault Test Button

This button is used to test the operation of the ground fault relay.

Instrument Power Input - CB2

This breaker protects the input circuit to the Instrumentation Potential Transformers.

Voltage Regulator Input - CB4

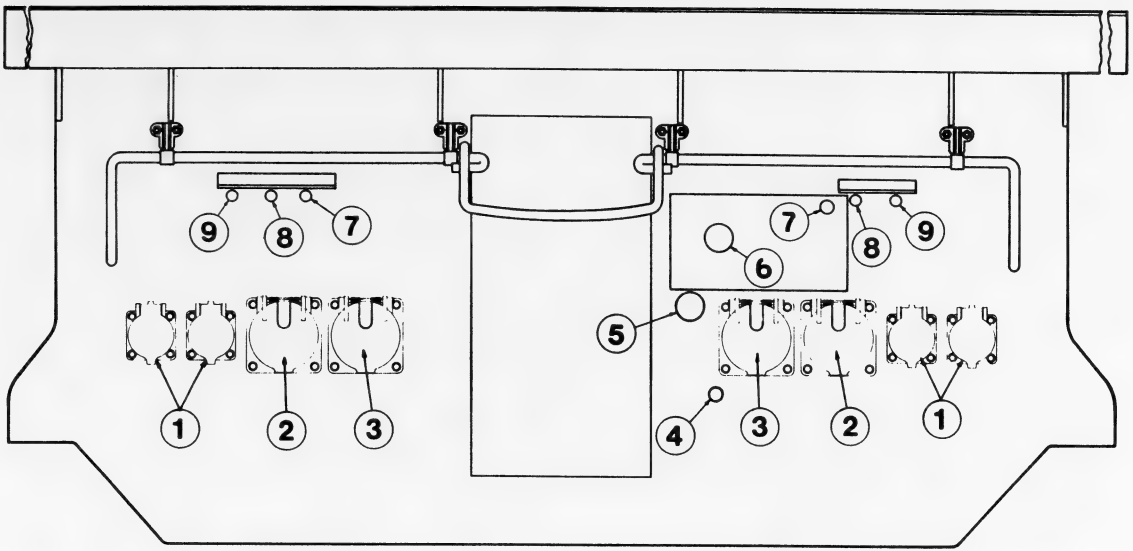
This breaker protects the current potential transformer for the voltage regulator.

Engine Hot Start - CB8

This breaker protects the circuits to the KIM hot start heater in the HEP engine.

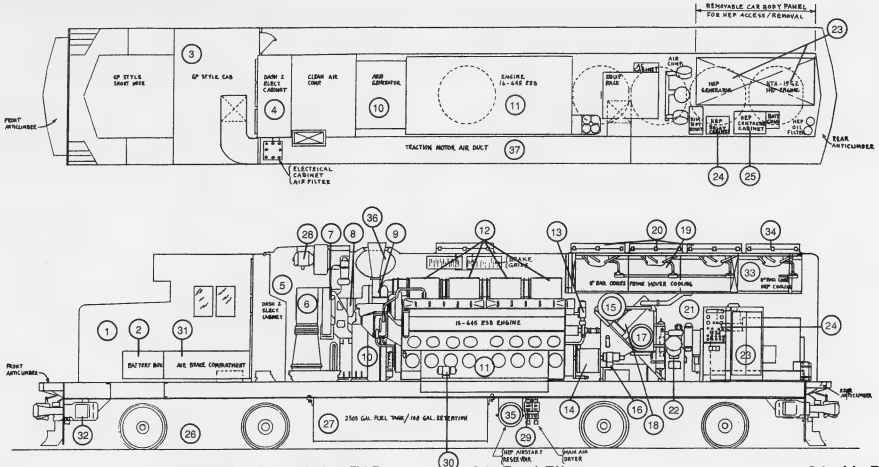
Battery Charger - CB10

This breaker protects the circuits to the battery charger. The battery charger system does not function when the main propulsion engine is operating. When the main engine is shut down, the battery charger will draw power off the 480V trainline to maintain the proper charge on the locomotive battery.



1. 480 V HEP Receptacle
2. 27 PT. Door/Communication Receptacle (Blue)
3. 27 PT. Locomotive MU Receptacle (Black)
4. Signal Pipe Hole
5. Car Main Reservoir
6. Brake Pipe
7. Main Reservoir Equalizing Pipe
8. Actuating Pipe
9. Independent Equalizing Pipe

Fig 2-29 Pilot Plate Receptacle Arrangement



1. Sand Box (Front/Rear)
2. Battery
3. Control Stand
4. Electrical Cabinet
5. Intertial Air Filter
6. Traction Motor Blower
7. Generator Blower
8. Auxillary Generator
9. Turbo Charger
10. Main Generator
11. Diesel Engine 16-645E3B
12. Exhaust Manifold
13. Engine Governor
14. Lube Oil Strainer
15. Engine Water Tank
16. Fuel Pump
17. Lube Oil Filters
18. Lub Oil Cooler
19. Radiators
20. Radiator Cooling Fan
21. Fuel Filter
22. Air Compressor
23. HEP Plant
24. HEP Relay Cabinet
25. HEP High Vollage Cabinet
26. Truck
27. Fuel Tank
28. Intertial Air Discharge Fan
29. Air Dryer
30. Turbo Lube Oil Pump
31. Air Brake Compartment
32. Coupler/Draft Gear
33. HEP Cooling Expansion Tank
34. HEP Cooling Fan
35. HEP Air Start Reservoirs
36. Exhaust Silencer
37. Main Air Reservoirs
38. Emergency Fuel Cut Off (Both Sides)

Fig. 2 GP40PH-2 Locomotive General Arrangement

Section 3

Operation

Introduction

This section covers recommended procedures for operation of the locomotive. The procedures are briefly outlined and contain summary explanation of equipment location and function.

Warning

Assure that the hand brake is applied and at lease one wheel is blocked at both sides before preparing for service or leaving unattended.

Preparation for Service

Ground Inspection

Check for the following:

1. Leakage of fuel oil, lube oil, water, or air.
2. Loose or dragging parts.
3. Proper hose connections between units in multiple setup.
4. Proper positioning of all cocks and valves.
5. Air cut-in to truck brake cylinders.
6. Satisfactory condition of brake shoes.
7. Fuel supply.
8. Proper installation of control cables between units.

Lead Unit Cab Inspection

On the lead or control locomotive, the control locations described in Section 2 should be checked and the equipment positioned for operation as follows:

Fuse and Switch Panel (Fig. 2-21)

1. Main battery switch closed.
2. Check that the **Start Fuse** is installed and in good condition, and of the correct rating. Verify that the Main Battery and Ground Relay Cutout switches are closed.

Circuit Breaker Panel

1. At the circuit breaker panels, check that all breakers in the black areas are in the **On** position.
2. Other circuit breakers **On** as required.
3. At the No. 2 circuit breaker panel, verify that the ground relay cut-out switch is **closed**.

Engine Control Panel

1. Isolation switch in **Start** position.
2. DB/BL cut-out switch in **Up** position.
3. Miscellaneous switches positioned as required.
4. Remote Traction Motor Cutout switch, in **Motors All In** position.

Note

The electrical cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

Operator's Control Stand

Switches and operating handles on the control stand, Fig. 2-2, should be positioned as follows:

1. Place Control and Fuel Pump switch in **On** (up) position. **Note:** This must be placed in **On** position on opposite control stand.
2. Place Engine Run switch and the Generator Field switch in the **Off** (down) position.

3. Light and miscellaneous switches positioned as desired.

4. Move throttle handle to **Idle**. Position reverser handle to **Neutral** and remove before starting diesel engine.

26L - Air Brake Equipment

1. Insert automatic brake valve handle (if removed) and place in Lap position. This will nullify the application of any safety control equipment used.

2. Insert Independent Brake Valve handle (if removed) and move to **Full Application** position.

3. Position Cut-off Valve to In position.

4. Place Dual Ported Cut-out Cock in the Lead (horizontal) position.

Starting the Diesel Engine

After the following inspections have been completed, the diesel engine starting procedure may be initiated.

Engineroom Inspection

The engineroom equipment can be inspected through the cab door or any of the various wide body access doors.

1. Check air compressor for proper lube oil supply.

2. Check that water level, in water tank sight glass, is near the Full (Engine Dead) mark on the water level instruction plate. **Note:** Water level should be rechecked when engine is running. Level should be near Full (Engine Running) mark.

3. Check all valves for proper positioning.

4. Observe for leaking of fuel oil, lube oil, water, or air.

Engine Inspection

The engine should be inspected before as well as after starting.

1. Check that overspeed mechanism is set.
2. Check that the governor low oil pressure trip plunger is set, and that oil is visible in the governor sight glass.
3. Check that the crankcase (oil pan) pressure and low water pressure detector reset buttons are set (pressed in). If either button protrudes, press and hold button for 5 seconds immediately after engine starts.
4. Check that engine top deck, air box and oil pan inspection covers are in place and are securely closed.
5. Pull out oil level gauge (dipstick) from side of engine oil pan. Oil gauge should be coated with lube oil.

Note

A properly filled lube oil system will coat the oil gauge above the Full mark when the engine is stopped. To obtain an accurate check, recheck level, when the engine is idling and at normal operating temperature.

Engine Starting

After the preceding inspections have been completed, the diesel engine starting procedure can begin.

Note

If engine temperature is near freezing, preheat engine before attempting to start. Prelube engine if it has been shut down more than 48 hours unless

the **KIM** layover system has been operating. Refer to Engine Maintenance Manual for prelube procedures.

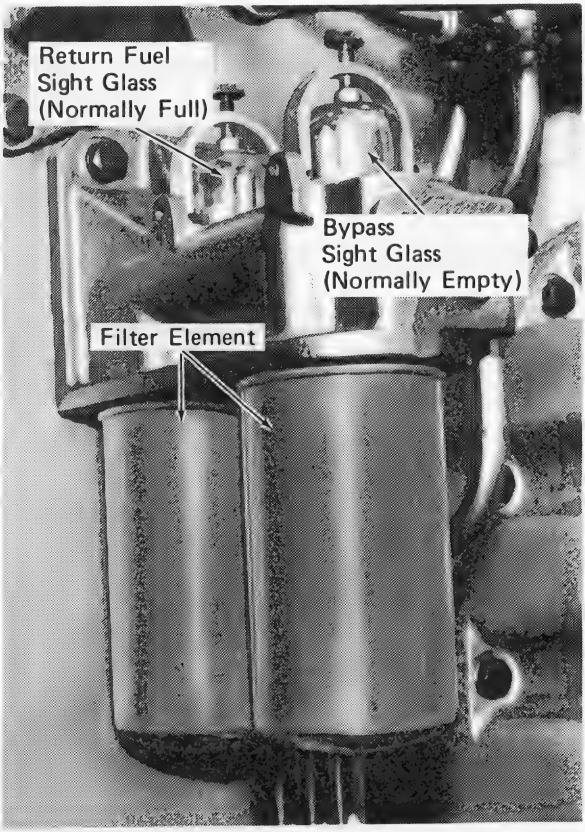


Fig. 3-1 Fuel Oil Sight Glasses

Engine Starting Procedure

1. At the operator's control stand, make certain that the Generator Field and Engine Run switches are **Off** (down). Verify that the Control and Fuel Pump switch is **On** (up) on both control stands.

Note

When starting trailing unit diesel engines and control cables have been connected between units, the Control and Fuel Pump switch should remain **Off.**

2. At the engine control panel, verify that the Isolation switch is in the **Start** position.

3. At the equipment rack, place the Fuel Prime/Engine Start switch in the **Fuel Prime** position until fuel flows in the return fuel sight glass, Fig. 3-1, clear and free of bubbles (normally 10 to 15 seconds).

Caution

This engine is equipped with an engine purge control system. Do not push injector control level until engine has cranked for 6 seconds.

4. Position injector control level (layshaft) at about one-third rack (about 1.6 on the governor scale), after engine has cranked for about 6 seconds. Move the fuel prime/engine start switch to Engine Start position. Hold the switch in this position until the engine fires and speed increases, but not more than 20 seconds.

Caution

Starter motors should not be allowed to crank engine for more than 20 seconds. If engine fails to start after 20 seconds have elapsed, allow 2 minutes for starter cooling.

5. Release injector control lever when engine comes up to idle speed. Do not advance lever to increase speed until oil pressure is confirmed.

Note

Engine water inlet temperature should be allowed to reach 120° F before load is applied. After idling in extremely cold weather, increase to full load should be made gradually.

6. Check both low water pressure detector reset buttons after the engine starts. If tripped, press button to reset detector. The engine will shut down after a short time delay if the detector is not reset.

Note

If the detector is difficult to reset after engine starts, confirm oil pressure, then position the injector control lever (lay shaft) to increase engine speed for a short time, and press the reset button.

7. Check the following with the engine running and at normal operating temperature.

    a. Coolant level is near the Full (Engine Running) mark on the water level instruction plate.
    b. Lube oil level is near the Full mark on oil level gauge (dipstick).
    c. Governor oil level.
    d. Compressor lube oil level.

Trailing Unit Cab Inspection

Switches, circuit breakers, and controls located in the cab of a trailing unit should be checked for proper positioning as follows:

Fuse And Switch Panel

1. Main battery knife switch closed
2. Start Fuse installed and in good condition, and of correct rating.

Circuit Breaker Panel

1. All breakers in the black area of the circuit breaker panels in **On** position.
2. Other circuit breakers **On** as required.
3. Verify that the ground relay cut-out switch is **On**.

Engine Control Panel

1. Isolation switch in **Run** position.
2. Blended and dynamic brake cut-out switch positioned according to New Jersey Transit operating procedures for trailing units.
3. Miscellaneous switches positioned as required.
4. Remote traction motor cut-out switch in **Motors All In** position.

Note

The electrical cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

Operator's Control Stand

Switches and operating handles on the control stand should be positioned as follows:

1. Generator Field switch, and Engine Run switch must be **Off**.
2. Move throttle to **Idle**. Position reverser handle to **Neutral** and remove to lock other handles.
3. Light and miscellaneous switches positioned as desired.
4. Control and fuel pump switches must be **On** at both control stands.

26L - Air Brake Equipment

1. Place automatic brake valve handle in Handle

Off position. Remove handle.

2. Place independent brake valve handle in Release position. Remove handle.
3. Place Cut-off Valve to Out position.
4. Place Dual Ported Cut-out Cock in Trail (vertical) position.

Starting Trailing Unit Diesel Engines

Engines in trailing units are started in the same manner as the engine in the lead unit. Refer to "Starting The Diesel Engine" portion of this section.

Note

If control jumper cables are already connected between units, ensure that the Control and Fuel Pump, Generator Field, and Engine Run switches are **Off**. This will allow these systems to be controlled from the lead unit.

Placing Units On The Line

After the diesel engines are started and inspected, units may be placed on the line as desired by placing the isolation switch on the engine control panel in the cab in the **Run** position. If the consist is at a standstill, be certain that the throttle handle in all units is in the **Idle** position before placing any unit on the line.

Precautions Before Moving Locomotive

The following points should be carefully checked before attempting to move the locomotive under its own power:

1. Make sure that main reservoir air pressure is normal. **This Is Very Important, Since The Locomotive Is Equipped With Electro-Mag-**

netic Switchgear Which Will Function In Response To Control And Permit Operation Without Air Pressure For Brakes.

2. Check for proper application and release of air brakes.
3. Release hand brake and remove any blocking under the wheels.

Caution

It is desirable that engine water temperature be 120° F or higher before full load is applied to the engine. After idling at ambient temperature below 0° F, increase to full load level should be made gradually.

Handling As A Light Locomotive

With the engine started and placed "on-the-line" and the preceding inspections and precautions completed, the light locomotive is handled as follows:

1. Place the Engine Run switch and Generator Field switch in **On** (up) position (only on control stand being used).
2. Place headlight and other lights **On** as needed.
3. Insert reverser handle and move it to the desired direction of travel, either forward or reverse.
4. Release air brakes.
5. Open throttle to position No. 1, 2, or 3 as needed to move locomotive at desired speed.

Note

Locomotive response to throttle movement is almost immediate. There is little delay in power buildup.

6. Throttle should be in **Idle** before coming to a complete stop.

7. Reverser handle should be moved to change direction of travel only when locomotive is completely stopped.

Draining Air Reservoirs And Filters

The air reservoirs and filters should be drained at least once each day even through equipment is provided with automatic drain valves. Draining should be done in accordance with New Jersey Transit Air Brake Instructions, TRO-4. Drain valves should be operated as follows:

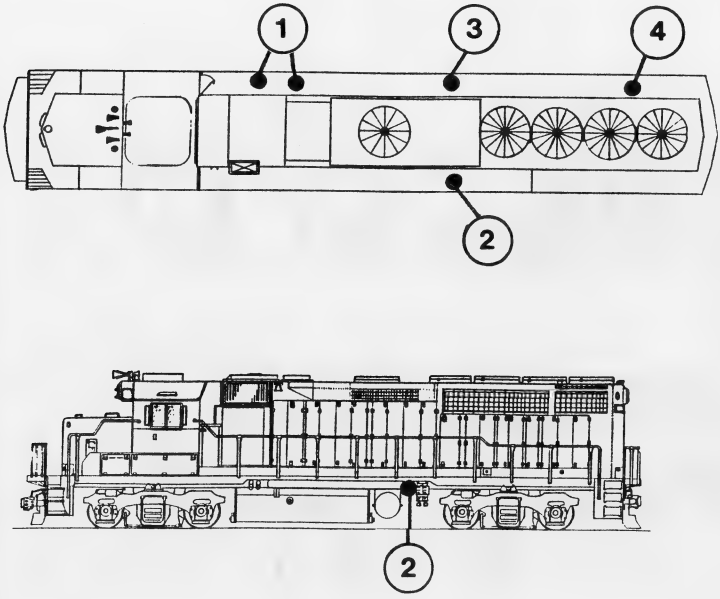
1. Automatic drain valves: There is **one** automatic drain valve at the #1 main reservoir. See Fig. 3-2 for location.

   Drain reservoir by turning handle clockwise not more than one turn. After reservoir is drained, turn handle counter-clockwise until it stops against the seat.

2. Manual drain valves: There are **four** manual drain valves. One at the #2 Main Reservoir, one at the HEP airstart reservoir and one each at the Salem Air Filters. See Fig. 3-2 for locations.

   Drain Reservoir or filter by turning handle counter-clockwise until reservoir or filter starts to drain.

   After reservoir or filter is drained, turn handle clockwise until it stops against the seat.



1. Salem Air Filter Manual Drain Valves (2 each)
2. #1 Main Reservoir Automatic Drain Valve
3. #2 Main Reservoir Manual Drain Valve
4. HEP Airstart Reservoir Manual Drain Valve

Fig. 3-2 Compressed Air System Drain Valve Locations

Engine Air Box Drain

A metal casting mounted on the front end plate of the engine connects drain pipes from each side of the airbox to a common drain pipe. Pressures in opposition at the casting restrict airflow to a permissible amount, yet allow elimination of airbox contaminants. The system is completely automatic and requires no attention by the locomotive operator.

Coupling Locomotives Together

When coupling units together for multiple unit

operation, the procedure below should be followed:

1. Couple and stretch units to ensure couplers are locked.
2. Install control cable between units.
3. Attach platform safety chains between units.
4. Perform ground, engineroom, and engine inspections, as outlined in preceding articles.
5. Position cab controls for trailing unit operation as outlined in preceding articles. Remove reverser handles from all controllers to lock controls.
6. Connect air brake hoses between units.
7. Open required air hose cut-out cocks on each unit.
8. Make a setup of the brakes on the consist to determine if brakes apply on each unit. Brakes then must be released to determine if all brakes release. The same procedure must be followed

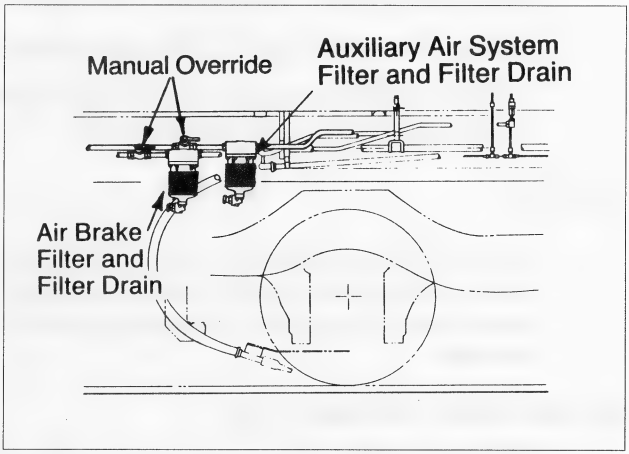


Fig. 3-3 Air Brake, Main Reservoir and Auxiliary Systems Drains and Filter Drains

to check the independent brake application. Also, release an automatic service application by depressing the independent they are released.

Coupling Locomotive to Train

Locomotive should be coupled to train using the same care taken when coupling units together. After coupling, make the following checks:

1. Test to see that couplers are locked by stretching connection.
2. Connect air brake hoses.
3. Slowly open air valves on locomotive and train to cut in brakes.
4. Pump up air using the following procedure.

Pumping Up Air

After cutting in air brakes on train, note the reaction of the main reservoir air gauge. If pressure falls below trainline pressure, pump up air as follows:

1. Place Generator Field switch in Off position.
2. Move Reverser Handle to Neutral position.
3. Open throttle as needed to speed up engine and thus increase air compressor output.

Note

Throttle may be advanced to No. 5 if necessary. Engine should not, however, be run unloaded (as in pumping air) at speeds beyond throttle No. 5 position.

Brake Pipe Leakage Test

Prior to moving a train, a brake pipe leakage test must be performed. Brake pipe leakage tests

should be made in accordance with the New Jersey Transit air brake instructions.

Starting HEP Plant

Prior to starting the HEP plant, specific inspections and preparations are mandatory to prevent damage to the equipment.

Warning

In a locomotive consist only one HEP plant can be used per train. Do not attempt to use more than one plant, as safety devices will prevent you from putting the second plant on-line.

Cab Inspection

Switches on the Remote Head End Power Panel should be positioned as follows:

1. **Idle Run** switch should be placed in the **Idle** position.
2. **Trainline Set Up** switch should be placed in the appropriate mode.
3. The **Trainline Complete Mode** switch should be in position for the proper selection of trainline pin nunber.

Engine Room Inspection

High Voltage Cabinet

Breakers on this panel should be positioned as follows:

1. Cooling Fan Motor - CB6 ..... **On**
2. Main Engine KIM Heater - CB7 ..... **On**
3. AC Disconnect Motor - CB9 ..... **On**
4. Instrument Power Input - CB2 ..... **On**
5. Voltage Regulator Input - CB4 ..... **On**

6. Cummins Engine KIM Heater - CB8 ..... **On**
7. Battery Charger - CB10 ..... **On**
8. Air Conditioner - CB11 ..... **On**
   (As Needed)

Engine Inspection

1. Check that coolant water level is satisfactory.
2. Observe for leakage of fuel oil, lube oil or water.
3. Pull out oil level gauge (dipstick) from side of block and verify that oil level is on full.

Relay Cabinet

Switches and breakers in this cabinet, under normal start conditions, should be set as follows:

1. Idle Run Switch ..... **Idle**
2. Battery breaker ..... **On**
3. Instrument Power Output breaker ..... **On**
4. Voltage Regulator ..... **On**
5. Fuel Pump Aux. Reset button ..... **Push**
6. Alarm Reset button ..... **Push**
7. Ground Fault Reset button ..... **Push**

Starting Procedure

After the procedural inspections have been completed and the operating switches verified to be in the correct position, the engine starting procedure can begin.

1. Press **Start** button. Hold button in until engine starts. Do not hold button in for longer than 20 seconds.
2. Unit will come up to idle speed, and the **Phase** lights will glow dimly. Voltage meter should read approximately 250V when engine is running normally at idle speed.

3. After engine warms up, place **Idle Run** switch in the **Run** position.Both relay and remote switches must be in **Run** position.

4. Check the AC Voltmeter to determine that alternator is producing 480V AC, that the Frequency Meter Indicates 60Hz and that both **Phase** lights are bright.

5. Press the **AC Power On** button. The HEP unit is now on line, the green Contactor Closed indicator light is now on at both the Relay Cabinet and the Remote Head End Power Control Panel.

Starting A Train

The methods to be used in starting a train depend upon factors such as weight and length of the train and amount of slack in the train; as well as the weather, grade and track conditions. Since these factors are variable, specific train starting instructions cannot be provided and it will therefore be up to the operator to use good judgment in properly applying the power to suit requirements. There are, however, certain general considerations that should be observed. They are discussed in the following paragraphs.

A basic characteristic of the diesel-electric locomotive is its high starting tractive effort, which makes it imperative that the air brakes be completely released before any attempt is made to start a train.

The locomotive possesses sufficiently high tractive effort to enable it to start trains without taking slack. Care should be taken to prevent excessive acceleration which will cause undue shock.

Proper throttle handling is important when starting trains. As the throttle is advanced, a power increase occurs immediately. Power applied is at a value dependent upon throttle position.

When ready to start, the following general procedures is recommended.

1. Place Isolation Switch in **Run** position.
2. Move Reverser Handle to the desired direction, either **Forward** or **Reverse**.
3. Place Engine Run and Generator Field switches in the **On** position (only on control stand being used).
4. Release both Automatic and Independent air brakes.
5. Open the throttle one notch every few seconds to accelerate.

Accelerating A Train

After the train has been started, the throttle can be advanced as rapidly as desired to accelerate the train. The speed with which the throttle is advanced depends upon demands of the schedule and the type of locomotive and train involved. In general, however, advancing the throttle one notch at a time is desired to prevent slipping.

The load indicating meter provides the best guide for throttle handling when accelerating a train. By observing this meter it will be noted that the pointer moves toward the right (increased amperage) as the throttle is advanced. As soon as the increased power is absorbed, the meter pointer begins moving toward the left. At that time, the throttle may again be advanced. Thus for maximum acceleration without slipping, the throttle should be advanced one notch each time the meter pointer begins moving toward the left until full power is reached in throttle position No. 8.

Air Braking With Power

Note

Automatic blending of dynamic brakes with

the air brake system is not performed unless the throttle is in *Idle* position.

The method of handling the air brake equipment is in accordance with New Jersey Transit Air Brake Instructions. However, when braking with power, it must be remembered that for any given throttle position, the draw bar pull rapidly increases as the train speed decreases. Therefore, power braking is not a recommended practice.

Power At Stall

Do not hold the train at standstill on a grade or with the brakes applied and the throttle open for power. Extensive damage to the traction motors is possible.

Operating Over Rail Crossing

When operating the locomotive at speeds exceeding 25 MPH, reduce the throttle to No. 4 position at least eight seconds before the locomotive reaches a rail crossing. If the locomotive is operating in No. 4 position or lower, or running less than 25 MPH, allow the same interval and place the throttle in the next lower position. Advance the throttle after all units of the consist have passed over the crossing. This procedure is necessary to ensure decay of motor and generator voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

Running Through Water

Under absolutely no circumstances should the locomotive be operated through water deep enough to touch the bottom of the traction motors. Water any deeper than 3" above the rail is likely to cause traction motor damage. When passing through any water on the rails, exercise every precaution under such circumstances and always go very slowly, never exceeding 2 to 3 MPH.

Wheel Slip Correction

Instantaneous reduction of locomotive power together with automatic sanding functions to correct wheel slip. After adhesion is regained, a timed application of sand continues while power is smoothly restored. The system functions entirely automatically, and no action is required by the locomotive operator.

Depending upon the seriousness of the slipping condition, the wheel slip light may or may not flash on and off as the wheel slip control system functions to correct the slips. However, the wheel slip control system reacts so rapidly to correct minor slips that the wheel slip light seldom comes on to indicate severe slips. The wheel slip corrective action is often seen at the load current indicating meter as a steady reduction of load current below that which is normally expected a full throttle for a given speed. Do not misinterpret this power reduction as a fault. It is simply the wheel slip control system doing its job and maintaining power at a level within the adhesion conditions established by track and grade.

Note

Whenever possible, operation on grades should be at full throttle position. Throttle reduction during wheel slip is recommended only when:

1. Repeated wheel slip conditions cause severe lurching that may pull a train apart. (Such severe conditions may indicate the need for a helper or the need to take the train up the hill in two parts.)

2. In unusual conditions, simultaneous wheel slips may be incurred at low or stall speed. In this situation the performance of the equipment is directly related to the skill and judgment of the

operator. Therefore, the operator must determine to apply sand to the rail and/or reduce throttle.

Wheel Slip Light

If the wheel slip light blinks on and off persistently or burns continuously during locomotive operation, a pair of wheels may be sliding or circuit difficulty may exist. Due to the seriousness of sliding wheels, under such indications the locomotive should be **Immediately Stopped** and an investigation made to determine the cause. The wheels may be sliding due to a locked brake, damaged traction motor bearings, or broken pinion or gear teeth.

Repeated ground relay tripping, accompanied by unusual noises such as thumping or squealing, may also indicate serious traction motor trouble that should be investigated at once. Do not allow any unit that must be isolated due to repeated wheel slip or ground relay action to remain in a locomotive consist **Unless It Has Been Absolutely Determined That All Of Its Wheels Rotate Freely.**

Locomotive Speed Limit

The maximum speed at which the locomotive can be safely operated is determined by the gear ratio. This ratio is 57:20. The 57 indicates the number of teeth on the axle gear while the 20 represents the number of teeth on the traction motor pinion gear. Since the two gears are meshed together, it can be seen that for this ratio the motor armature turns approximately three times for a single revolution of the driving wheels. The locomotive speed limit it therefore determined by the maximum permissible rotation speed of the motor armature. Exceeding this maximum could result in serious damage to the traction motors. For this gear ratio, the maxi-

mum operating speed is 102 MPH. Locomotive overspeed protective equipment is an electro-pneumatic arrangement applied in conjunction with cab signal equipment (see Cab Signal Equipment Manual). This equipment initiates certain air brake functions which reduce train speed.

Mixed Gear Ratio Operation

If the units of the consist are of different gear ratios, the locomotive should not be operated at speeds in excess of that recommended for the unit having the lowest maximum permissible speed. Similarly, operation should never be slower than the minimum continuous speed (or maximum motor amperage) for units having established short time ratings.

Blended Brake System

The dynamic air module provides the circuit logic and control for the blended brake system. The overall function of this module is to maintain a uniform braking rate using both the dynamic and air brake systems simultaneously-the dynamic and air brake systems are "blended" together. The blended system is designed to engage automatically whenever certain control system conditions are satisfied and the automatic brake valve handle is put in a service position above a minimum level. The blended system will also engage automatically whenever an emergency brake application is detected regardless of control system conditions.

For an emergency brake response the DA13 module provides only a partial application of dynamic brakes.

The blended system was designed to make full use of dynamic brake capability by using maximum dynamic brake strength as a reference and supplementing this braking effort with air braking. In this way blending ensures complete utilization of dy-

namic brakes with less use of air brakes.

The Blended Brake Lockout relay BBL is picked up by the blended brake lockout circuit of the DA module if total braking effort goes abnormally high for an extended period. When the BBL relay picks up it causes the following events to occur:

1. Dropout of Dynamic Brake Transfer relay DBT which eliminates system conditions necessary for blended braking.
2. Trainline alarm bell will ring throughout locomotive consist.
3. The Blend Brake L.O. light on the engine control panel will go on in the affected unit.

Note

The alarm bell can be silenced by moving the Blended & Dyn. Brake Cutout Switch on the engine control panel to the **Cutout** position.

If the Blended Brake Lockout relay (BBL) is picked up, it mechanically latches in and must be manually reset with the **Reset** switch on the relay. The BBL relay is located behind the upper middle door of the main control cabinet.

The brake warning circuit will give warning by a light and alarm buzzer when the unit is generating excessive current in dynamic braking. Thus regardless of the load indicating meter reading, whenever the warning light comes on, it should not be allowed to remain on for any longer than two to three seconds before steps are taken to reduce braking strength.

Note

If brake warning indications are repeated, the locomotive should be taken out of blended-dynamic

braking by placing the dynamic and blended brake cut-out switch on the engine control panel in the cut-out position.

Dynamic Brake Wheel Slip Control

During dynamic braking, each series group of two traction motors is connected in parallel with each dynamic braking resistor grid circuit and with the other series connected traction motors. With this arrangement, when a wheel slips it may be motored by other motors in the system. This in effect makes a wheel slip during dynamic braking somewhat self correcting. However, the parallel arrangement of dynamic braking resistor grids and traction motors is such that the full response of the wheel slip control system is available during dynamic braking as well as during power operation. The precise and immediate regulation maintained, plus the motoring effect created by the parallel arrangement, provides extremely stable dynamic brake operation.

In addition to the above, a bridge circuit is employed to protect against the possibility of simultaneous slips that may not be detected otherwise.

When a pair of wheels is detected tending to rotate at a slower speed, the retarding effort of the traction motors in the unit affected is reduced (traction alternator field excitation is reduced in the unit affected) and sand is automatically applied to the rails. When the retarding effort of the traction motors in the unit is reduced, the tendency of wheel set to rotate at slower speed is overcome. After the wheel set resumes normal rotation, the retarding effort of the traction motors returns (increases) to its former value. Automatic sanding continues for 3 to 5 seconds after the wheel slide tendency is corrected.

Double Heading

Prior to double heading behind another locomotive, make a full service brake pipe reduction with the automatic brake valve, and place the Cut-off Pilot valve in **Out** position. Remove the automatic brake valve handle and the independent brake valve handle. Place the Dual Ported Cut-Cock in the Lead/Dead (horizontal) position. Place the EP brake switch in **Off** position. If other unit(s) is(are) not equipped with a blended brake system, place the dynamic and blended brake cut-out switch in **"Off"** position.

The operation of the throttle is normal, and the brakes are controlled from the lead locomotive.

Operation In Helper Service

Basically, there is no difference in the instructions for operating the locomotive as a helper or with a helper. In most instances, it is desirable to get over a grade in the shortest possible time. Thus, wherever possible, operation on the grades should be in the full throttle position. The throttle can be reduced, however, where wheel slips cause lurching that may threaten to break the train.

Isolating A Unit

When the occasion arises where it becomes advisable to isolate a locomotive. Operating personnel should take proper action in compliance with standards established by New Jersey Transit.

Changing Operating Ends

When the locomotive consist includes two or more units with operating controls, the following procedure is recommended in changing from one operating end to the opposite end on locomotives equipped with 26L/CS2 brakes.

On End Being Cut Out (Trail)

1. Move the Automatic Brake Valve to **Service** position and make a full service reduction. (*) (See note below.)
2. After brake pipe exhaust stops, place Cut-Off Valve in Out position by pushing knob in and turning to the desired position. (*)
3. Place Independent Brake Handle in fully released position and remove. (*)
4. Place Dual Ported Cut-out Cock in **Trail** (vertical) position. (*)
5. Position the Automatic Brake Valve Handle in the **Handle Off** position and remove. *
6. With throttle in **Idle**, place the Reverser Handle in **Neutral** position and remove it to lock the controls. (*)
7. Place all switches in the **Off** position. Be absolutely certain that the Control and Fuel Pump Switch, Generator Field Switch, and Engine Run Switch are in the **Off** position. (*)
8. At the circuit breaker panels, all circuit breakers in the black areas are to remain in the On position.
9. After completing the operations outlined in the preceding steps, move to the cab of the new lead unit.

*Always Check Both Control Stands

On End Being Cut In

1. At the control stand, make certain the Generator Field Switch is **Off**. (*) (See note below.)
2. Insert Reverser Handle and leave in **Neutral** position. (*)

3. Place Automatic Brake Valve Handle in **Lap** position to nullify any safety control, overspeed, or train control used. (*)
4. Insert Independent Brake Valve Handle (if removed) and move handle to full independent application position. (*)
5. Position Cut-off Valve to **In** position. (*)
6. Place Dual Ported Cutout Cock in **Lead** position (horizontal). (*)
7. At the circuit breaker panels, check that all circuit breakers in the black areas are in the **On** position.
8. At the engine control panel, place switches **On** as needed.
9. Place the Control and Fuel Pump, and Engine Run Switches in **On** position. Other switches may be placed **On** as needed. (*)
10. At the unused control stand place the control and fuel pump switch in the **On** position. (*)

*Apply Only at Control Stand Being Used.

Stopping Engine

There are six ways to stop the main engine:

1. Press Main Engine **Stop** Button on Engine Control Panel. When the locomotive is standing still or under power, the isolation switch should be placed in **Stop** position. The Main Engine Stop Button can then be pressed in to stop the engine. The Main Engine Stop button should be held in for two seconds until the engine stops. Pressing this button does not affect the operation of the HEP unit.
2. Press Emergency Fuel Cut-off Button. Emergency Fuel Cut-off Pushbuttons are located near

each fuel filler opening and on the Engine Control panel. These pushbuttons operate in the same manner as the Main Engine Stop Button and should be held in for two seconds until the engine stops. **Note:** Pressing these buttons will also shut down the HEP engine.

3. Use injector control lever by pulling outwards. The injector control lever can be operated to override the engine governor and move the injector racks to the no fuel position.

4. Close the low water detector test cock. When the low water detector trips, oil is dumped from the governor low oil shutdown device, stopping the engine.

5. Use throttle handle. To stop all locomotive engines "on the line" in a consist simultaneously from the cab of the lead unit, move the throttle to the **Idle** position, pull the handle out and away from the controller, and move it beyond **Idle** to the **Stop** position. (Locomotives "off-line" will not shut down.)

6. Pull out low oil shutdown plunger on the side of the governor.

HEP Unit Shutdown Procedure

1. Press the **AC Power Off** Button to open the AC contactor. Power is no longer being fed to the passenger cars.

2. Turn the **Idle Run** Switch to the **Idle** position. Continue running engine in the **Idle** mode until the unit has cooled down.

3. When unit has cooled down, press the **Stop** button.

4. Turn all operating breakers to the **Off** position.

Freezing Weather Precautions

As long as the diesel engine is running, the cooling system will be kept adequately warm regardless of ambient (outside) temperatures encountered. It is only when the engine is shut down or stops for any reason that the cooling system requires protection against freezing.

If the main engine and the HEP engine are both shutdown, then the unit should be connected to wayside layover power, and the layover system energized. Two red low water temperature warning lights, located on each side of the carbody behind the cab, will be lit if the main engine cooling water temperature drops to 55° F indicating that the layover system is not maintaining adequate water temperature.

When danger of freezing is present and layover protection is not available, the cooling system should be completely drained or have steam admitted. The basic valves are illustrated in Fig.3-4.

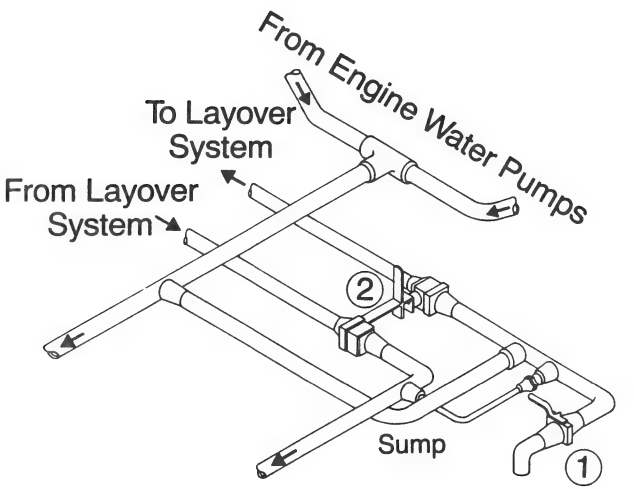


Fig.3-4 Engine Drain Valve Locations

Draining the Cooling System

The engine cooling system should be drained in the event that the diesel engine is stopped and danger of freezing exists. The draining procedure is as follows:

Drain Engine Cooling System

Make sure that the engine water drain is open. This valve is located in the engine drain sump, governor end, of engine.

After system pressure is released, remove the water tank fill cap, Fig.3-5.

Cooling System

For normal filling - **DO NOT** remove pressure cap. Attach hose at fill connector and hold fill valve open.

Caution - If pressure cap must be removed, **DO NOT** attach hose to fill pipe. Hold fill valve open until tank is completely vented. Then remove cap. When replacing, hold fill valve open so cap can be fully tightened as shown.

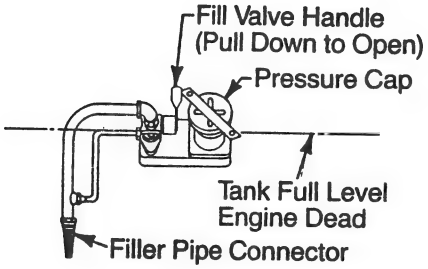


Fig.3-5 Cooling Pressure Cap and Filler Relief Arrangement

Caution

If a hot engine is drained, always allow the engine to cool before refilling with fresh coolant.

Towing Locomotive In Train

When this locomotive unit which is equipped with 26L/CS2 air brakes is placed within a train consist to be towed dead, control and air brake equipment should be set as follows:

1. Drain all air from main reservoirs and air brake equipment unless engine is to remain idling.
2. Place the Dual Ported Cutout Cock in Dead (horizontal) position. (*) (See note below.)
3. Place Cut-off **Valve** in **Out** position. (*)
4. Place Independent Brake Valve handle in Release position and remove. (*)
5. Place Automatic Brake valve handle in handle **Off** position and remove. (*)
6. Cut in dead engine feature by turning Cutout Cock, Fig.2-7, to open (90° to pipes) position. Dead Engine Cock is located beneath cab floor and may be reached through ride side access door below the cab.
7. If engine is to remain idling, switches should be positioned as follows:

    a. Isolation Switch in **Start** position.

    b. Battery Switch and Ground Relay Cutout Switch closed.

    c. Generator Field circuit breaker **Off**.

    d. All breakers in the black areas of the circuit breaker panel in the **On** position.

    e. Control and Fuel Pump Switch **On** (up). (*)

    f. Fuel Pump circuit breaker **On**.

    g. Throttle in **Idle**. h. Reverser Handle removed.

8. If locomotive is to be towed **Dead** in a consist, switches should be positioned as follows:

   a. Battery Switch open.

   b. All circuit breakers **Off**.

   c. All control switches **Off**.

   d. Starting fuse removed.

   e. Throttle in **Idle**. Remove reverser from controller to lock the controls.

   *Both Control Stands

Caution

If there is danger of freezing, the engine cooling system should be drained. Refer to Freezing Weather Precautions.

Leaving Locomotive Unattended

If, at any time, it is necessary to leave the locomotive unattended while the engine is running, the following procedure should be adhered to:

1. Observe all New Jersey Transit operating rules, air brake instructions, and local supervisory instructions.
2. Place Engine Run and Generator Field Switches in the **Off** (down) position.
3. Place throttle in **Idle**. Remove reverser handle from controller to lock the controls.
4. Place isolation switch in **Idle**.
5. Make full service application with Automatic Brake Valve.
6. Apply Independent Brake.
7. Apply the Hand Brake.

8. Turn off all lights not required for safety precautions.
9. Close all doors and windows.
10. Chock/block both sides of at least one wheel.

Section 4

Troubleshooting

Introduction

This section covers operational problems that may occur on the road and suggests action that may be taken by the operator in response to the trouble. Safety devices automatically protect equipment in case of faulty operation of almost any component. In general this protection is obtained by one of the following methods.

1. Complete shutdown of the diesel engine, or complete elimination of a function.
2. Unloading of the diesel engine and restriction to idle engine speed. In some instances manual resetting of the function may be necessary, or automatic resetting after a time delay may be provided.

Condition	Probable Cause	Suggested Operator's Response
Lead unit **Hot Engine Light** on; alarm bell ringing; engine running, but engine speed and power reduced.	Temporary operating condition. May be due to unusual operating conditions.	No action unless alarm persists If alarm continues for more than a few minutes, check that shutters motors are open and radiator blower motors are operating. Also check for proper coolant level.
	Low coolant level.	The unit should be shut down if coolant level is low or if there are coolant leaks. **Caution** If it is necessary to shut down the engine in freezing weather, the cooling system should be drained or otherwise protected to prevent freezing.
	Shutters not operating properly.	If shutters are closed, the manual shutter control valve may be set toTest position. The unit should be shut down if the shutters do not open.
	Radiator blower motors not operating.	If radiator blower motors are not operating, the 200-ampere fuses, located in the AC cabinet, may be open. The unit must be shut down before replacing

		the fuses. The unit should be shut down if the blower motors do not operate.
Lead unit **Engine Air Filter** light on; engine running, but engine speed and power reduced.	Plugged engine air filters and/or plugged inertial filters.	No immediate action required. Operation may continue at reduced power. Condition to be reported at first maintenance point.
Lead unit **Fil Motor Trip** light on. Engine Running.	Filter blower Motor Circuit breaker tripped or left Off.	Reset breaker or turn it On. If breaker trips again, leave it Off. Operation may continue; condition to be reported at first maintenance point.
Lead unit **Grd. Relay** light on; alarm bell ringing.	Lead unit ground relay operation.	Take no action for 10 seconds; then press the ground relay reset push button on the control stand. The ground relay pushbutton should not be pressed more than three times within any consecutive30 minute period. If ground relay operation is caused by traction motor flashover or weakened traction motor insulation, it may be possible to continue operation of the unit by cutting out the defective traction motor. Observe instructions on engine control panel when necessary to cut out a traction motor.

Condition	Probable Cause	Suggested Operator's Response
		The unit should be isolated and shut down if more than three ground relay operations occur within any consecutive 30 minute period.
Lead unit **No Batt. Charge/No Power** light alarm bell ringing; engine at speed or shut down.	No D14 alternator output voltage.	If the unit shuts down, check the 6-ampere Aux Gen Field circuit on; breaker and the 100-ampere Auxiliary Generator circuit idle breaker. Also check the engine overspeed trip lever. Reset the circuit breaker or the engine overspeed trip lever and restart engine. If the overspeed trip lever or the circuit breakers trip again, the unit should be isolated and shut down. If the unit remains at idle speed, check the 15-ampere AC Control circuit breaker. If the above circuit breakers are not open and the engine overspeed trip lever is set, the unit should be isolated and shut down.

Lead unit **Governor Down** light on; alarm bell ringing; engine shut down.	Low water detector button tripped.	If both the Hot Engine and the Governor Down lights are on, the unit should be isolated. Do not attempt to restart the engine. Report engine shutdown to authorized maintenance personnel. If the crankcase pressure detector button is set, but the low water detector button and the governor low oil plunger are tripped, perform thorough check of the following items. 1. Cooling water level satisfactory. 2. Cooling water temperature satisfactory. 3. No visible oil leaks or water leaks. 4. Governor oil level satisfactory. 5. Engine lube oil level satisfactory. If all items are normal, the engine may be restarted and placed on the line after resetting the low water detector button and the governor If the Governor Down light comes on again, the unit should be isolated and shut down. Hot oil or low If the low water detector button governor oil and the crankcase pres-

Condition	Probable Cause	Suggested Operator's Response
		sure detector button are set but the governor low oil plunger is tripped, do not attempt to restart the engine. Isolate the unit and notify authorized maintenance personnel.
	Crankcase pressure detector tripped.	**Warning** If crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. If freezing conditions are possible, drain the cooling system or other- wise protect the system from freezing.
Intermittent **Wheel Slip** light indications.	Normal wheel slip correction under severe conditions.	No action required. Do not reduce throttle unless slipping is so severe that it threatens to break the train.
Excessive **Wheel Slip** light indications.	Locked sliding wheels.	Check that all wheels on the locomotive rotate freely. Do not operate a locomotive unless all wheels rotate freely.

Turbo Pump light on.	Normal condition for 35 minutes after engine start or stop.	No action necessary.
PCS Open light on.	Penalty brake application.	**Note** Observe railroad regulations after any penalty or emergency brake application. To regain power, move throttle to Idle and automatic brake handle to suppression position, then to release position.
	Emergency brake application.	Move throttle to idle. Move automatic brake handle to emergency position and wait 45 seconds, then move automatic brake handle to release position.
	Faulty or disconnected car door circuit.	Use appropreate by-pass switch.
Engine will not crank.	Circuit breakers or switches in proper position.	Refer to Section 3 for engine starting procedures.

Condition	Probable Cause	Suggested Operator's Response
	EP module not operating properly.	Bar the engine over one full revolution, then hold Bypass switch on EP module closed while cranking engine.
	Immersion heater or external battery charging cables connected.	Disconnect immersion heater or external battery charging cables.
	Starting fuse defective.	Check fuse and replace if necessary.
Alarm bell rings; no alarm lights on in lead unit.	Trailing unit hot engine.	Refer to lead unit Hot Engine
	Trailing unit low water detector button tripped.	Refer to lead unit Governor Down.
	Trailing unit hot oil or low governor oil.	Refer to lead unit Governor Down.
	Trailing unit crankcase detector button tripped.	Refer to lead unit Governor Down.
	Trailing unit-No D14 alternator output voltage.	Refer to lead unit No Batt. Charge/No Power light on.

	Trailing unit - Ground relay.	Refer to lead unit Ground Relay operation.
	Trailing unit - HEP fault.	Refer to lead unit HEP Troubleshooting.
Brake Warn light.	Regulating system failure.	Place dynamic and blended brake cut out switch on engine control panel in the Cutout position.

HEP Unit Troubleshooting

Failure To Start	Lack of proper air pressure.	Check the items; take appropriate corrective action and repeat the start procedure.
	Low battery voltage.	Check the items; take appropriate corrective action and repeat the start procedure.
	Engine failure fault not cleared.	Check the items; take appropriate corrective action and repeat the start procedure.
	All circuit breakers not On.	Check the items; take appropriate corrective action and repeat the procedure.
Main Contactor Won't Close	Idle-run switch not in Run.	Place switch in Run.
	Water temp. relay tripped.	Press alarm reset pushbutton.

Condition	Probable Cause	Suggested Operator's Response
	HEP trainline not complete; one okay. Both lights not lit.	Check for trainline cable loose or not properly installed.
	HEP ground relay tripped.	Press ground reset pushbutton
Main Contactor Opens; Engine Runs	HEP fault condition (over-under frequency, over-under voltage, over-current, or ground relay).	Make sure frequency and voltage are correct; press alarm and ground relay reset pushbuttons. If fourth trip occurs, isolate unit.
	Loss of trainline loop.	Re-establish trainline loop.
Engine Shuts Down	Low oil pressure.	Check oil level; add oil if low.
	Low water level.	Add water to HEP expansion tank.
	Engine overspeed	Adjust governor for proper 1800 RPM operation in Run.
	Hot engine.	Check for proper operation of cooling fan and proper water level.

		Reset tripped cooling fan motor circuit breaker. Check that temperature switch plug is properly installed.
	HEP stop or locomotive Emergency Fuel Cut-Off (EFCO) pushbutton has been pressed.	Press Fuel Pump Aux. Reset pushbutton and restart engine.
Main Contactor Opens; Engine Shuts Down	Main contactor opens whenever engine stops.	See Engine Shuts Down above.